

MAR 24 1921

# Railway Age

**DAILY EDITION**

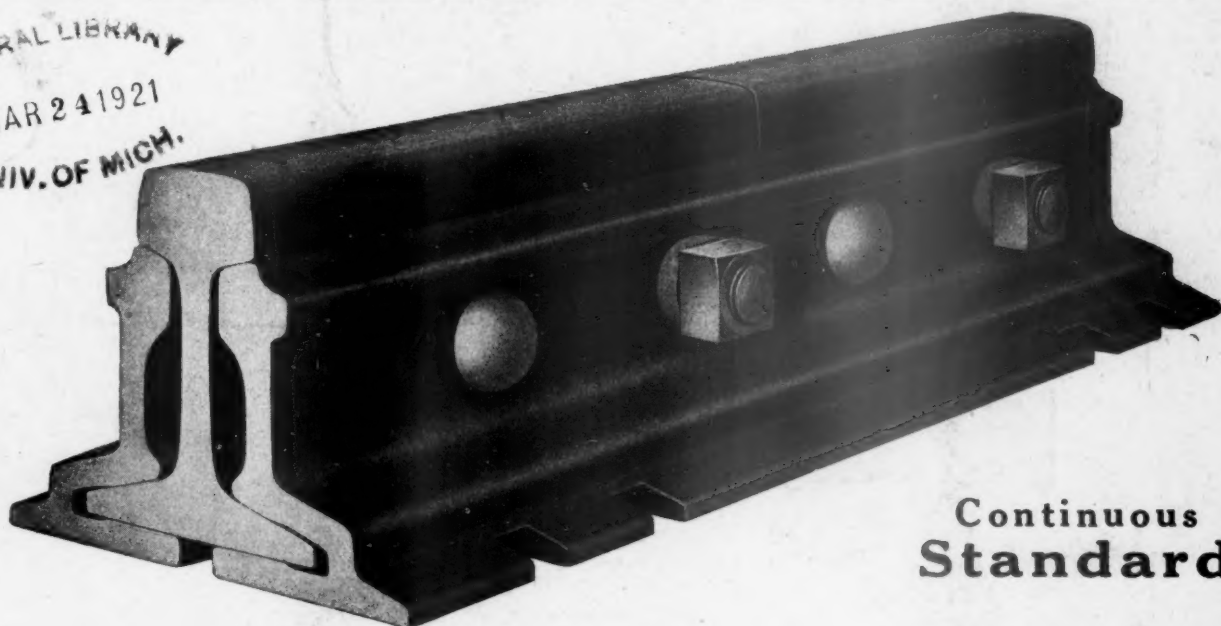
FIRST HALF OF 1921—No. 10c

CHICAGO—THURSDAY, MARCH 17, 1921—NEW YORK

SIXTY-SIXTH YEAR

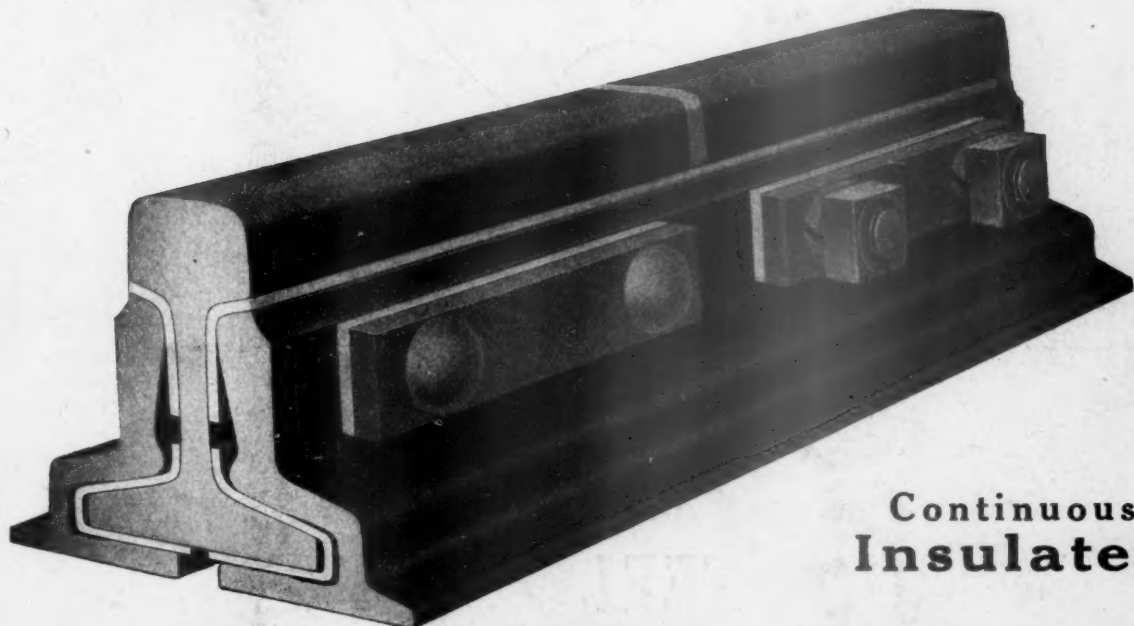
Published weekly by Simmons-Boardman Pub. Co., Woolworth Bldg., New York, N. Y. Subscription Price U. S., Canada and Mexico, \$8.00; foreign countries (excepting daily editions), \$10.00; single copies, 25c. Entered as second-class matter, January 30, 1918, at the post office at New York, N. Y., under the act of March 3, 1879. Daily edition application made at the post office at Chicago, Ill., for entry as second class matter. Chicago office, Transportation Building.

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# EDITORIAL

## Railway Age

DAILY EDITION

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It is becoming more evident every day that railroading is becoming more scientific. Evidences of this are reflected in the report of the Committee on Economics of Railway Operation, which included progress reports on such important subjects as "Methods for Increasing the Traffic Capacity of a Railway," "The Effect of Speed of Trains on Cost of Operation" and "The Determination of the Traffic Capacity of Single and Multiple Track Railways." In the early days of railway development in this country only a limited amount of attention was given to the consideration of operating economies. However, as the regulation of railway earnings has become increasingly strict, it has been necessary for them to reduce operating expenses in every manner possible. This has made necessary the more thorough study of many problems. At the present time, when the capacity of the railroads is so greatly taxed with each upward surge of traffic and when intensive improvement work is largely out of the question, studies of means of increasing the capacity of existing facilities are becoming of increased importance. Although organized only a couple of years ago, the committee has undertaken an ambitious program and has already made gratifying progress. It is to be hoped that

#### Engineers and Operating Problems

the American Railway Engineering Association will lead in the recognition of the value of the application of trained men to the analytical discussion of railway problems by the creation of other committees as occasion warrants. While continuing the consideration of those problems of a more particularly engineering nature, the Association can also contribute to the promotion of efficient railway operation by the consideration of these larger problems.

Engineering colleges generally have made considerable progress in recent years by broadening out their courses to include instruction in management and other matters concerning the human element and its relation to production. This is as it should be, and it is to be hoped that still greater progress will be made in this direction. The human machine is the most complicated piece of mechanism imaginable and it must be intelligently and scientifically supervised if the best results are to be obtained. Engineering societies generally have realized the importance of this and their programs in recent years have been giving more and more attention to matters relating to the handling of men in industry. It is of great importance that this be appreciated by railroad engineers because of the scattered forces on the railroads and the difficulty of providing adequate supervision.

#### Human Element in Engineering

In the article on "Humanizing Engineering Education," which appears in this issue, Professor A. A. Potter has pointed out clearly that the proportion of students graduating in engineering courses is far too small and that the educational system is at fault. The fact that only a small

#### Why Not Broaden the Engineer at the Start

percentage graduate is only too well known, but it has usually been considered as an index to the standards of the school. Professor Potter now raises the question whether it is at all indicative of the standards of the institution or of the ability of the student. He believes that it is not and states that it is purely a matter of holding the student through stimulating his interest by introducing more engineering matter early in the curriculum. He further advocates, and for that matter is actually practicing at Purdue University, the study of the characteristics of men in order that the interest of the student may be continually sustained and his knowledge broadened. There is much to this. The students who drop out or change their course of study are by no means failures in their after work in life. In fact, a large proportion do achieve a success comparable with that of the graduate engineer. It has been chiefly a case in the past of following certain interests, modified more or less by natural though perhaps indefinable instincts. The successful business man of today has some understanding of engineering matters. On the other side, the successful engineer has, through either interest or necessity, acquired a knowledge of people, of business and of other matters. Thus, if we

can intelligently combine and sustain the interests and instincts of the students at the start of their education we will have laid the foundation for not only a larger number of graduates, but for a better and broader class of men. And the engineering profession will have been benefited thereby.

Because a man is a master workman is no reason why he will be successful in directing a gang or a force of men.

#### Training of Foremen

It takes years of practice to make a good craftsman, even in handling simple machines or materials. And yet because a man may be a good workman and appear to have a certain potential ability as a leader, he is often promoted and placed in charge of men with little, if any, instruction in handling them. What is the result? Sometimes he makes good, sometimes he just scrapes through, and often he fails and has to be set back. With an intensive course of instruction in the handling of men more of these foremen will make good in a decided fashion and at a very much smaller expense to the railroad—an expense which often is not apparent because it is reflected in friction, decreased production and lost motion. A great industrial organization has found it profitable to provide special courses of instruction in handling men for all of its foremen, old and new. Is there not a suggestion here by which the railroads can increase their efficiency?

One of the basic maintenance of way materials which is now undergoing a marked transition is the cross tie.

#### Rendering a Valuable Service

The hardwood tie of a couple of decades ago has largely given way to that of the softer woods. Used originally as cut in the timber, they are now being treated with preservatives in increasing quantities. More attention is also being given each year to experimentation with substitute ties of steel, concrete and other materials. The Committee on Ties is performing a valuable service in presenting a report on the progress of these developments from year to year. Thus the report presented yesterday contains recommendations for methods of installing and keeping records on test sections to determine data as to the service life of cross ties of various materials and treatments. The annual presentation of information concerning the results which are developing currently in the experimental installations of substitute ties also constitutes a valuable record of importance which will be more fully appreciated as the cost of wooden ties continues to increase to the point where those of other materials are more practicable commercially.

No committee has a larger or more important field for investigation ahead of it than that on Economics of Railway Labor. The labor problem is now of paramount interest in all branches of railway service. Nowhere, however, are greater opportunities afforded for the promotion

#### The Labor Agent Returning Again

of efficiency, with a corresponding reduction in expenses, than in the consideration of maintenance of way labor. So many conditions have developed which have tended to drive the more efficient men from this work that the efficiency of the rank and file has deteriorated to a low level. In its report, the committee calls attention to one of the most serious defects in the handling of maintenance of way labor—the inefficient manner of hiring men for employment. Prior to federal control, the practice

prevailed of leaving the selection of men to labor agents, who most generally derived their compensation from boarding and commissary concessions. In spite of the evident viciousness of this system, the committee points out that this practice is again coming into vogue, following the return of the roads to private control. With the selection of men left to persons not directly in railway employment, and with no attempt to pick out the more capable or experienced, little improvement can be expected. The committee can perform no more important service than to develop a system by means of which some consideration can be given to the qualification of a man in hiring him for maintenance of way work.

### The Classification of Old Bridges

JUDGING FROM THE COMMENTS made in the course of discussion of the report on Iron and Steel Structures, the subject covered in this year's work—namely that on Rules and Unit Stresses for Rating Existing Bridges—is one of the most important ever taken up by the steel bridge committee. A further evidence of this is to be seen in the character of the discussion as reported elsewhere in this issue. In spite of some of the adverse criticism it must be conceded that the rules prepared by the committee are an excellent work that will go far to place the investigation of old bridges on a generally systematic basis. The discussion was of value in bringing out some pertinent truths on the methods under which such rules should or should not be applied.

Practice in making decisions as to old bridges covers a wide range of variation from an extremely empirical study based almost entirely on judgment and experience to a most exacting mathematical analysis. In view of the fund of information now available and the possibility of checking up stresses in indeterminate members with the extensometer, there is no excuse at the present time for relying on "educated guesswork" unless lack of time or a competent staff is an admissible alibi. This being the case, the real question at hand, as brought out in this discussion, relates to the method under which the true mathematical analysis applied under the rules adopted yesterday shall be applied.

Opinions were agreed on one point, the decision must be made by an officer who is thoroughly competent and, what is equally important, whose opinion will carry weight with the management. Since bridge engineering is so highly technical, requiring closer application than a chief engineer can give it, it would seem clear that this responsibility should rest primarily with the bridge engineer or one who is a bridge engineer by training if not by title.

But on all but the smallest of roads, the bridge engineer can not himself make the detailed inspections and all computations required to carry out the complete investigation. He must delegate part of the work to others and herein lies a difficulty. In some cases the inspection and the mathematical analysis are completely segregated—the man who does the figuring rarely sees the structure. But while there are serious objections to this plan, it is sometimes difficult to work out any other feasible arrangement. On the larger roads it is a problem also to say to what degree the bridge engineer shall have a personal part in the investigation.

These are problems of personnel and organization in the bridge engineer's office that are equally as important as the discussion of the rules presented at the session yesterday. Of particular moment is the need for impressing the management with the fact that this is highly exacting work requiring a thoroughly competent staff.

## The Railways and the Universities

**A** VERY LARGE PART OF THE TROUBLES of the world are due to ignorance. Most of the present troubles of the railroads of the United States undoubtedly are due to ignorance. Part of this ignorance is that of many railway officers concerning fundamental engineering and economic principles which must be applied to secure the greatest efficiency and economy of operation. Part of it is ignorance of railway employees, who do not understand the advantages they would gain from more efficient and economical operation and the disadvantages they suffer from every form of inefficiency and waste. Part of it is ignorance of the public and public men regarding the public policies in regulating the railways which must be followed if they are to be adequately developed and enabled to give good service at the lowest practical cost.

President Kinley of the University of Illinois in his address at the dinner last night discussed the subject of co-operation between the universities and the American Railway Engineering Association. There can be no doubt whatever that closer co-operation between the railways and educational institutions would, in the long run, reduce this ignorance and be of great benefit both to the railways and the public. The universities need in their work the practical point of view and knowledge of the working railway officer. If the university professors had more understanding of practical railway problems their pupils would go into active life better equipped to deal intelligently with railway problems, whether those of railway management or railway regulation. On the other hand, if there were more of the thorough scientific study of railway engineering, operating and economic problems which can be best done in the universities, and if railway managements were more disposed to use the results of such studies, the art of railroad transportation would be more rapidly advanced. The railroads could well afford to give more co-operation and support to university work along the lines of engineering economics and business administration. The greatest progress in every line of industrial endeavor depends upon a well-balanced combination of scientific investigation and practical administrative effort. In no other industry is this more needed than in the great railroad industry.

## Humanizing Engineering Education\*

**I**N CONNECTION with the question of engineering education, which is a most important one to the country and this Association, it is always believed that the best results are produced as far as instruction is concerned by the teaching of men and not subjects. That means we should pay greater attention to the testing and sorting of students before they are assigned to any particular course of study and that their progress must be carefully watched.

We should give more attention to the teaching of students, how to study and improve their personal efficiency, and that we should rate them not only on their academic performance, but certain personal traits. Every effort should be exerted to develop not only their memory, their knowledge of technique, but also to develop certain traits of personality such as initiative, judgment, leadership and other qualities which are so essential for success in engineering and industry.

The conditions which existed when most of you gentlemen were at school and which existed when I was at college was that the young high school graduate, as he

entered the university to study engineering, became immediately discouraged, because he found that instead of becoming acquainted with engineering problems he was made to devote all of his time during the first two or three years to certain abstract subjects. He could not see any connection between the subjects he was studying and the engineering profession for which he was preparing. Little attention was paid to the effect of failure, or the cause of failure, on the part of college students; in fact, I know in some cases university professors boasted of the fact that they had a high mortality among the students. In many cases certain institutions claim high standards because they start with 100 freshmen and graduate 25 or 30 seniors—that was taken as a criterion of high quality. If a factory superintendent would lose 25 per cent of his castings continuously day after day he would not hold his job very long.

We have not recognized the fact that failure on the part of the student to carry a certain subject may not be due entirely to his indifference, but may be due to poor teaching, and also to the fact that the student is not interested in the subjects which he is studying. In order to correct this a great many of the engineering schools at the present time are introducing in the larger courses certain subjects which are very closely related to engineering. At Purdue we are giving to every freshman a course in engineering problems, at the same time trying to acquaint him with certain problems of particular interest to his community, such as roads, water supply, sewage disposal, etc.

Another thing that I am personally interested in is to stimulate the college student in doing good work by giving recognition to his efforts and rewarding them. We are all familiar with the effect of publicity upon athletics. We all know the effect upon athletics by having space given to athletic events in the dailies, by having the pictures of the contestants appear in the paper. We know what a large stimulus that type of publicity gives. It would seem that if a student is relegated to the brain squad the results of his studies should be given some publicity. If a student excels in surveying or mathematics, or any other subject, we make it a point to send a little story about it to his home paper as well as to the college paper, and we find that that type of publicity is of great advantage in keeping the student interested in his work.

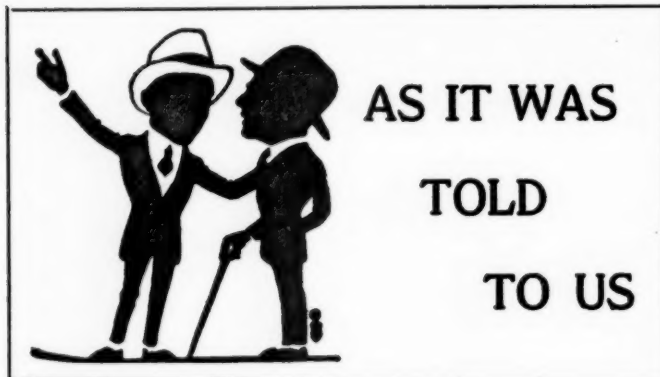
Another thing you may be interested in is that we are making a very careful study of the students' characteristics, and some of the qualities that pertain to the student's personality. We are also having the students graded on initiative and judgment, and other qualities, not only by his teachers, but by his chums, classmates and people in his home town, and we are using that information, to some extent, in advising the student concerning the selection of the course of studies.

## Today's Program

The program for the American Railway Engineering Association sessions today is as follows:

Committee VI.	Buildings .....	Bulletin 235
Committee VIII.	Masonry .....	Bulletin 233
Committee I.	Roadway .....	Bulletin 234
Committee XVII.	Wood Preservation.....	Bulletin 233
Committee VII.	Wooden Bridges and Trestles.....	Bulletin 233
Committee XIV.	Yards and Terminals.....	Bulletin 235
Committee XII.	Rules and Organization.....	Bulletin 234
Committee XI.	Records and Accounts.....	Bulletin 235
Committee XIX.	Conservation of Natural Resources..	Bulletin 235
	New Business	
	Election and Installation of Officers	
	Adjournment.	

\*At the invitation of President Safford, Prof. A. A. Potter was given the privilege of the floor for a few minutes yesterday morning. This is an abstract of his talk.



H. B. MacFarland, a member of the Rail Committee and formerly engineer of tests of the Atchison, Topeka & Santa Fe, has just returned from a visit to England where he supervised the application of the Lewis draft appliance to a British locomotive.

A. L. Grandy, assistant general manager of the Pere Marquette, with headquarters at Detroit, Mich., has been appointed chief engineer and the position of assistant general manager has been abolished. J. Tuttle, chief engineer, has been appointed assistant chief engineer.

W. K. Hatt, who was professor of Purdue University at the time H. R. Safford and L. A. Downs were students, said that he always knew they would amount to something when they left Purdue because they had a habit of running things while they were there.

Among those attending the convention this year for the first time is B. W. DeGeer, recently appointed engineer water service of the Great Northern. He is enjoying the convention keenly and expresses the opinion that the individuals who have had the opportunity to be present, likewise the railroads which they represent, cannot but greatly benefit from their experience here if in no other way than through the greater zeal with which they will return to their work at a time when this encouragement is greatly needed.

After an absence of several years John B. Seymour is again present at the exhibit at the Coliseum, although in a new connection. Mr. Seymour was formerly manager of the Western territory for the National Lock Washer Company, resigning this position in 1917 to enter the officers' training camp at Ft. Sheridan, following which he was commissioned and spent considerable time in active service overseas. Mr. Seymour has recently returned to the railway supply industry as manager of sales of the Western territory of the Verona Tool Works, with office at Chicago.

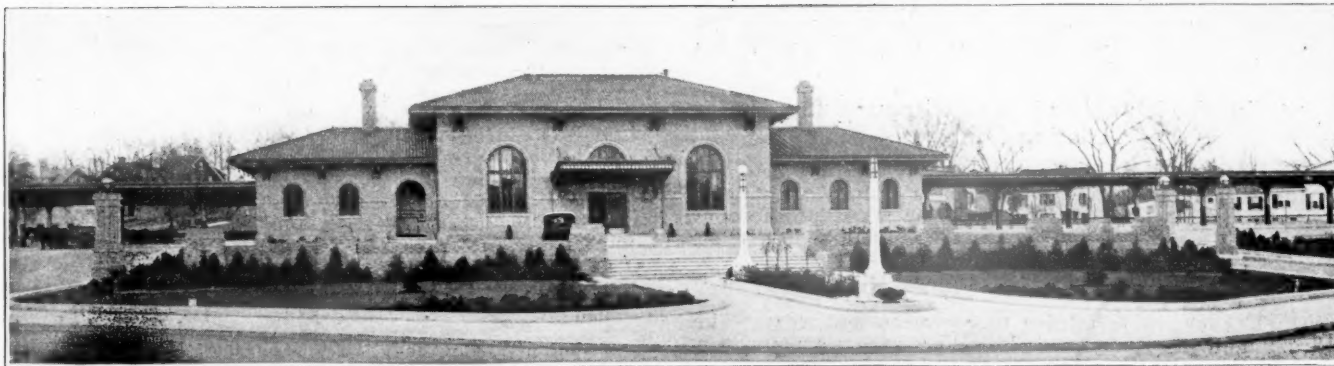
P. G. Lang, Jr., assistant bridge engineer of the Baltimore & Ohio at Pittsburgh, Pa., who is in attendance at the convention, was in direct charge of the design and construction of a new bridge over the Allegheny river at Pittsburgh, the last stage of which was completed yesterday with the opening of traffic over the eastbound track. This structure received considerable notice some time ago in connection with the completion of some exceedingly intricate erection operations involving the shifting and jacking of spans during a temporary interruption to traffic. With the completion of these changes on December 20 traffic was opened over the new structure on the west-

bound track. The work has now been completed on the east approach to this bridge so that traffic will be opened on the eastbound track, effective yesterday.

Frank Rhea, trade commissioner, United States Department of Commerce, is the member of the A. R. E. A. who is perhaps the farthest away from the convention at this time. Mr. Rhea is at present in Pekin, China, having left the United States last fall. Mr. Rhea spent some time in London and while there happened to meet another member of the Association, A. G. Shaver, who was in Europe studying the railroad situation at that time. In a letter recently received from Mr. Rhea, he states that he arrived at Shanghai on January 14 after a 42 day trip from London with only a two day stop at Singapore and less than one day stops at Gibraltar, Malta, Port Said, Aden, Colombo, Penong and Hongkong. As the ship usually arrived in these ports in the morning and left in the evening or night, Mr. Rhea stated that this did not give him much time to see these places, but that not much time was required for such places as Aden.

Of the members of the American Railway Engineering Association who arrived Monday none has a more interesting railway career than S. B. Rice, engineer maintenance of way of the Richmond, Fredericksburg & Potomac, and a member of the Ballast Committee of the Association. Mr. Rice entered railway service in November, 1865, as a carpenter on the construction of the Jamestown river bridge of the Richmond & Petersburg Railroad at Richmond. He entered the service of the R., F. & P. in June, 1866, since which time he has been continuously in the service of this railroad with the exception of a few months in 1867 and 1868. Mr. Rice thus has a record of over a half century of continuous service with one railroad. He was made a foreman of carpenters in 1873 and was promoted to master carpenter on the death of his father in 1880. He was made roadmaster of the Richmond, Fredericksburg & Potomac and the Washington Southern in 1900 and was promoted to engineer maintenance of way in 1910.

At the time Mr. Rice entered the service of this road certain portions were still laid with "U" rails weighing about 46 lbs. per yard. Some old strap rail was also in use on sidings. In reviewing his experiences in his early days Mr. Rice states that "railroading at that time on the R. F. & P. was more a pleasure than labor. The responsibility was so light that you hardly felt it. If we were putting in any new work such as bridges, culverts, or laying rail, all we had to do was to let scheduled trains pass, then go to work, knowing that we had the track until the next scheduled train, never putting out a flag. If there was to be an extra at any time, we would have been notified the previous day by what was known as a "red letter." If there was to be an extra train, one of these red letters would be thrown off by the engineer, the train stopping at the man it was addressed to and the men would take out the order, sign on the back of the envelope and return to the conductor to be turned over to the superintendent. Another practice in those days was that engineers at night were required to throw off at section houses a cast disc about  $\frac{1}{4}$  in. thick and 4 in. in diameter, this to show the number of the train that had passed. This was after we had commenced to number trains. Section masters, carpenters, and all maintenance of way employees were required to find this disc before putting a car on the track or fouling the line. Sometime they would lose considerable time before finding same. The discs were bundled up and returned to the master mechanic at Richmond for further use."



D. L. & W. Station at Morristown, N. J.

## Railway Engineering Association Proceedings

An Account of Wednesday Sessions Including Presentation of  
Ten Committee Reports With Discussions

THE SECOND DAY'S SESSION of the convention of the American Railway Engineering Association was called to order promptly at 10 o'clock yesterday morning by President Safford. The larger attendance at the convention was reflected in the fact that the room was completely filled throughout both the morning and afternoon sessions. Owing to inability to complete the entire program the reports of the committees on Standardiza-

tion and Uniform General Contract Forms were held over from the Tuesday morning session and were presented early Wednesday morning. These reports were followed by those scheduled for presentation on Wednesday and included: Signs, Fences and Crossings; Ties; Iron and Steel Structures; Water Service; Economics of Railway Labor; Economics of Railway Operation; Economics of Railway Location, and Shops and Locomotive Terminals.

### Report on Iron and Steel Structures

*This committee follows the policy of publishing certain criticisms of the specifications which it submits for approval with a view to eliciting more intelligent discussion on the floor of the convention. This practice has been carried out this year with respect to the Rules and Unit Stresses for Rating Existing Bridges. The Principles for Detailed Design of Flashing, Drainage, Reinforcement and Protection for Waterproofing Purposes cover the perfection of details which have been shown by experience to favor good workmanship and reduce the possibility of the chance fault that will cause a leakage at any point in the system.*



O. E. Selby  
Chairman

*O. E. Selby, chairman of the committee, has served in this capacity for the last four years, previous to which he was vice-chairman for five years. He has been a member of this committee for a total of ten years. Although Mr. Selby's present title is that of principal assistant engineer of the Cleveland, Cincinnati, Chicago & St. Louis, he carries the duties of bridge engineer and for a long time carried that title on that railway. As the head of the committee dealing with one of the most scientific subjects, it is to be expected that he is a man given to scientific study and investigation not only as to bridge work but to other railway matters as well.*

IN APPENDIX A ARE GIVEN the Rules and Unit Stresses for Rating Existing Bridges which were offered as a conclusion for printing in the Manual. A tentative draft of these rules was published in Bulletin 228 and the discussions received were considered in the revision. These discussions were presented by the committee in an Appendix B. The Principles for Detailed Design of Ballast Floors, Flashing, Drainage and Reinforcement for Waterproofing Purposes, published in Bulletin 223 and submitted as information to the 1920 convention, have been revised and are offered as a conclusion in Appendix C.

#### Conclusions

1. The committee recommended that the Rules and Unit Stresses for Rating Existing Bridges as printed in

Appendix A be approved and published in the Manual.

2. The committee recommended that the Principles for the Detailed Design of Flashing, Drainage, Reinforcement and Protection for Waterproofing Purposes appearing in Appendix C be approved and published in the Manual.

Committee: O. E. Selby (C. C. C. & St. L.), chairman; F. E. Turneure (U. of Wis.), vice-chairman; F. Auryansen (L. I.), J. A. Bohland (G. N.), W. S. Bouton (B. & O.), A. W. Carpenter (N. Y. C.), M. F. Clements (N. P.), J. E. Crawford (N. & W.), O. F. Dalstrom (C. & N. W.), F. O. Dufour (Stone & Webster), Thomas Earle, W. R. Edwards (I. C. C.), G. A. Haggander (C. B. & Q.), R. L. Huntley (U. P.), P. G. Lang, Jr. (B. & O.), B. R. Leffler (N. Y. C.), P. B. Motley (C. P. R.), C. D. Purdon (St. L. S. W.), Albert Reichmann (Am. Brg. Co.), A. F. Robinson (A. T. & S. F.), H. N. Rodenbaugh (F. E. C.), J. M. Salmon (L. & N.), I. L.

Simmons (C. R. I. & P.), I. F. Stern (Cons. Engr.), H. B. Stuart (G. T.), G. E. Tebbetts (Roberts & Schaefer), Dr. J. A. L. Waddell (Cons. Engr.), H. T. Welty (N. Y. C.), Paul Wolfel (deceased).

### Appendix A—Rules and Unit Stresses for Rating Existing Bridges

(1) In fixing the carrying capacity of any bridge under traffic, its location, design, details, material, workmanship, behavior, and physical condition must be taken into account.

(2) Before recalculating an existing bridge, a careful inspection should be made to determine:

(a) Whether the actual sections and details conform to the drawings.

(b) The loss of metal due to corrosion and wear. This determination should be made by caliper measurements, after thorough removal of scale.

(c) The general physical condition. Defects such as loose rivets, worn pins, crooked or damaged members, cracked metal, etc., should be carefully noted.

Particular attention should be given to the position of the track with respect to center line of the bridge, and to undesirable details, such as forked ends of compression members, eccentricity in riveted joints and connections, unequal stress in tension members, etc.

(3) In recalculating bridges for increased loading, the equipment in actual use, or which it is proposed to use, shall be taken for determining the live load stresses. Where the design or details are such as to cause eccentric or secondary unusual stresses, these stresses shall be taken into account. It is recommended that stresses in members subject to marked secondary effects be determined by strain gage measurements.

(4) In spans exceeding 150 ft. in length, and in viaduct towers, the effect of lateral (or wind) force shall be taken into account. The lateral force shall consist of a moving load equal to 15 lb. per sq. ft. on the vertical projection of the structure on a plane parallel with its axis, and a moving load of 400 lb. per lin. ft. applied 8 ft. above the base of rail.

(5) On curves, the centrifugal force, based on actual speed of operation, and assumed to act 6 ft. above the base of rail, shall be taken into account.

(6) Where speeds may exceed 15 miles per hour, the dynamic increment of the live load shall be added to the maximum computed live load stresses and shall be determined by the formula.

$$I = S \frac{300}{300 + \frac{L^2}{100}}, \text{ in which}$$

I = impact or dynamic increment to be added to the live load stress.

S = computed maximum live load stress.

L = the length in feet of the portion of the span which is loaded to produce maximum stress in the member.

Where maximum live load stress is produced by heavy cars or electric locomotives, impact stresses shall be taken as one-half of those given by the formula above.

(7) If a bridge is so located that speeds are definitely limited, or where absolute control of speed can be secured, 50 per cent of the impact given by the above formula shall be used when the speed is between 10 and 15 miles per hour, and 25 per cent when the speed is less than 10 miles per hour. If the bridge is located where the locomotive must be started, the speed increased, or the brakes applied, full impact shall be used in the calculations.

(8) Impact shall be added to stresses produced by centrifugal force, but not to those produced by lateral forces.

(9) For bridges on curves, and at other places where tracks are off center, consideration shall be given to the increased load carried by any truss, girder, or floor member due to the eccentricity of the load.

(10) The limiting stresses resulting from the loads and forces mentioned in the preceding articles, in combination with the actual dead load, shall not exceed the following, in pounds per square inch:

	Open-Hearth Steel	Wrought Iron and Bessemer Steel
Axial tension (net section).....	26000	22000
Axial compression (gross section).....	24000—80— r	21000—70— r
but not to exceed.....	20000	17000

l = length of the member in inches.

r = least radius of gyration of the member in inches.

Tension in extreme fibers of rolled shapes (except rolled beams and channels), built sections and girders (net sections)....26000

22000

Tension in extreme fibers of rolled beams and channels (net section) .....24000

20000

Compression in flanges of plate girders and I-beams (gross

section) .....26000—300—  
b

22000—250—  
b

but not to exceed.....24000

21000

l = length of the unsupported flange, between lateral connections or knee braces in inches.

b = flange width in inches.

Tension in extreme fibers of pins (figured by assuming stresses concentrated at centers of bearings) .....50000

40000

If the members are packed closely on the pin, the bending stress need not be considered unless the tension in extreme fiber exceeds 60000 lb. per sq. in. for open-hearth steel, or 50000 lb. per sq. in. for wrought iron and Bessemer steel.

Shear in plate girder webs and rolled beams (gross section).....18000

15000

Shear in rivets and pins.....22000

19000

Bearing on rivets, pins, outstanding legs of stiffener angles, and other steel parts in contact .....44000

38000

The above-mentioned values for shear and bearing shall be reduced 20 per cent for countersunk rivets, floor connection rivets, and turned bolts.

In members subject to stresses produced by a combination of dead load, live load, impact, centrifugal force, and eccentric application of dead and live load, with lateral forces or bending due to lateral action, unit stresses 25 per cent greater than those given in Article 10 may be allowed; but, in such cases, the unit stresses due wholly to dead load, live load, impact, centrifugal force, and eccentric application of dead and live load, shall not exceed those given therein.

(12) In hangers having an unequal distribution of load, and in hangers or hip verticals consisting of a single member, consideration should be given to the necessity for reducing the allowable unit stress to meet this condition.

(13) Stresses in plate girders shall be computed either by the moment of inertia of their net sections; or by assuming that the flanges are concentrated at their centers of gravity. In the latter case, one-eighth of the gross section of the web, if continuous or properly spliced, may be used as flange section. For girders having unusual sections, the moment of inertia method shall be used.

(14) When the stresses exceed the foregoing limits, or when the design or physical condition makes it necessary, the structure shall be strengthened or renewed.

When these limits are closely approached, or when the physical condition of the structure is not good, it shall be kept under close inspection as long as it is continued in service.

### Appendix C—Principles for Detailed Design of Flashing Drainage Reinforcement and Protection for Waterproofing Purposes

#### GENERAL

1. The following applies only to membrane waterproofing, as the "integral method" is not recommended for waterproofing railroad bridge floors.

2. The structure should be designed so that it can be waterproofed and it should be adaptable to waterproofing by ordinary methods and materials.

3. Strength and stiffness are desirable features in a structure which is to be waterproofed.

4. The structure and its construction and expansion joints, drainage and waterproofing, should be designed together, considering their separate and combined functions, so that each will help to secure a waterproof structure.

5. Due regard should be had for the available methods and materials of construction.

6. All waterproofed surfaces should be easily accessible, and as simple and smooth as possible; hence features should be avoided which would increase the difficulty of securing waterproof construction, such as open spaces, joints, holes, seams or projections.

7. Concrete bridge floors should be of ample strength and thickness and of dense non-porous construction. Special attention should be given to providing the correct amount and disposition of the reinforcement, and to securing the proper amount of water used in mixing.

8. Where contraflexure would injure the waterproofing, special details should be provided, such as elastic joints.

9. Minimize the number of construction joints in the structure, provided an ample number of workable expansion joints can be introduced.

#### DRAINAGE

10. Adequate drainage should be provided by means of suitable grades which will shed water by the easiest or most direct route. One per cent is a minimum desirable grade, but the grades away from points which are difficult to waterproof, should be correspondingly increased. While sewer and gutter grades may be considerably less than one per cent bridge floors, especially if ballasted, are subject to clogging by ashes, cinders, etc., and hence require steeper slopes to secure satisfactory drainage.

11. Avoid pockets which cannot be easily drained. Water with only a slight head may find an outlet through the waterproofing, which otherwise might be tight. Standing water is undesirable on a waterproofed bridge floor, from its destructive effect, both as a solvent and also on account of frost action.

12. Where gutters or pipes are necessary, they should be of durable material, of ample size, easy of access to install and maintain, and protected against clogging or damage. The grades should be enough to secure quick and entire escape of the water. Corrugated metal pipes are satisfactory where exposed to alternate freezing and thawing. Where sudden considerable variations in temperature occur, it is not desirable to encase drain pipes in concrete. Cleanouts and manholes should be provided where pipes cannot otherwise be cleaned.

13. Provide free exits for the harmless escape of drainage. Such drainage should not be allowed to disfigure the structure nor to injure persons or property. Icicles may be prevented by a basket of rock salt inserted in the top of the drain pipe.

14. Avoid features which would induce or permit capillary action.

15. Where possible, locate edges and joints above the highest probable water level.

#### REINFORCEMENT

16. Reinforcement of the structure should be suitably disposed, and ample in strength to prevent cracks or distortion which would injure the waterproofing.

17. Cloths, felts or fibers should be capable of holding the waterproofing pitch where placed and should be durable, strong and flexible.

18. Wire mesh or sheet metal reinforcement for the membrane should be of durable material, flexible where

necessary, and intimately bonded or introduced so that the waterproofing and reinforcement act together.

19. Necessary breaks in the surface of waterproofing or flashing, such as for drain pipes, or at construction or expansion joints, should be reinforced with extra flashing material.

#### FLASHING

20. Metal flashing shall be of material which is non-corrosive, and shall be insulated or protected against electrolytic action at points of contact with steel members of the structure.

21. Flashing should be of material which can be applied readily, and should retain the position in which it is placed when subjected to actual conditions of service and temperature.

22. Flashing should be firmly attached in its proper position, so that it cannot easily be displaced or removed.

23. The edges of waterproofing and flashing should be protected against drip, percolation and capillary action.

24. Joints between concrete and other material should be grooved and filled with an elastic expansion joint cement.

#### PROTECTION

25. Waterproofing and flashing should be protected, as soon as possible after installation, against mechanical injury, excessive temperature, chemical action, and deterioration caused by exposure to light and air.

26. The protecting covering should be dense, hard, durable and easy to apply.

It is recommended to use on flat surfaces either: (a) Brick laid in cement mortar or served with hot pitch, (b) plain or reinforced cement mortar, (c) plain or reinforced concrete, (d) bituminous mastic.

For surfaces with considerable slope, mastic is not satisfactory, being difficult to apply and also to retain in place.

#### Discussion

O. E. Selby, Chairman (C. C. C. & St. L.): You will recognize the distinction between rating existing bridges and the classification. Rating is figuring the unit stresses and deciding the capacity of the bridge. The classification is the assembling of the bridges on a railroad or on a division, together with the classification of the locomotives to be operated, and putting the information in the hands of the Transportation department, so that it may be available in assigning locomotives to the division, and for operating locomotives and other loads in emergency.

*I move the adoption of Conclusion No. 1.*

John B. Hunley (C. C. C. & St. L.): To my mind this is really more important than the specification for designing. There are a good many good specifications for designing new structures in particular, but there seem to be varied ideas as to the rating of old structures.

It seems to me the steel stresses are quite high, considering that even with the best inspection we cannot always find out the condition of the bridge. We are permitting under this proposed rating stresses of 20,000-lb. for actual tension of net sections, that is, wrought iron or Bessemer steel. I think we are going pretty far in recommending such high stresses, particularly old bridges of wrought iron and Bessemer steel. It is to my mind practically impossible to determine all the defects of the bridge by any inspection which can be made.

Chairman Selby: I will answer Mr. Hunley's first point in which he called attention to the inconsistency between the stresses by saying that in this case the designing stress is the one that existed and the proposed rating stress is correct. I will have to admit that the designing stress in Article 48 of the Specification is too low and is unduly conservative.

E. A. Frink (S. A. L.): These values that the committee has put forward, as I read them, seem to me to be about right in line with practice of bridge engineers whom I have learned to look up to as the heads of their profession.

At first sight it looks as though a stress of 20,000 lb. on ordinary iron is too large, but there are a number of factors that come into play in figuring the safety or carrying capacity of an existing bridge, which we cannot put down on paper. In every structure that is at all well designed, every part will help out—almost every part will help out another part.

C. F. Loweth (C. M. & St. P.): I am quite in accord with the expressions of the first speaker in this discussion, and I have a great many things to take exception to in the remarks that have just been made. The older bridges that we have to deal with in many cases have been well designed, and in many other cases the material of which they are composed is more or less uncertain. The record as to the quality of the material in the old bridges is not as definitely known as in the newer bridges today.

In my own practice I have frequently been compelled to carry in service old structures whose unit stresses were fully as high as those that are recommended by this committee, and I have tried to work these things out in a way that seemed to me to be wise and prudent. We have inspected bridges and calculated the load they will carry, and we have restricted the type of locomotive that should operate over that particular bridge, and then the tendency was to go away and forget it and just assume that that bridge was all right. You know the interval which elapses between the time you decide that a bridge must be changed for a heavier structure and the time in which it actually is changed. So we find that we are carrying our bridge without proper regard to the narrow margin of safety that we had agreed on.

I realize that you wish to make it clear that these specifications were not to apply to bridges to be carried indefinitely in service, but it seems to me that we ought to place considerable emphasis on the fact that those bridges are really weak sisters, and that careful inspection be given to them from time to time and frequent times, and that bridges that are stressed as high as proposed in these specifications are bridges which it is the intention of the company to replace at an early date.

Chairman Selby: Mr. Chairman, it seems to me that Mr. Lewis has answered himself. With reference to Article 14, which I read, and which Mr. Lewis called attention to, I think that covers the case precisely. If it is admitted, as Mr. Loweth seems to admit, that these stresses are safe under close inspection and watching, I do not see why we should not say so and go on record.

Mr. Hunley: That is one of the points I have in mind. We have practically gone the limit on stresses and at the same time depend on each and every instruction here given will be followed out. We all know that is not always the case. I think we should allow a little leeway for some such oversight as that.

Mr. Loweth: Perhaps the committee would be willing to lower these unit stresses and change Paragraph 14, to say that for bridges which for various reasons must be carried in service, and cannot be replaced promptly and which can be frequently inspected and kept in touch with, that the unit stresses as specified may be increased. That would simply add to the safe consideration.

G. H. Tinker (N. Y. C. & St. L.): I think it would be a mistake to adopt a lower unit of the specifications and then remove that limit by a permissive clause. In that case we have no standard whatever. I think the correct procedure is to adopt the top limit beyond which

we shall not go and to limit the application of these units in particular cases to something less than that, rather than to adopt the limit beyond which we may go under certain conditions, and in line with that I feel this Paragraph 11 is a mistake and should be omitted. Let the unit stress be fixed at a limit beyond which we may not go, and omit all provisions for a permissive stretch of these limits which this paragraph evidently does.

John V. Hanna (K. C. Ter.): The suggestion of the last speaker is very good. I know that it would be helpful to some of us, who do not specialize in this bridge work, if there could be an ultimate limit beyond which we should not go in continuing an old bridge in service.

P. B. Motley (C. P. R.): The units mentioned by the committee I think are about correct, as a general practice, and as has been mentioned on other occasions this specification or any specification is not intended to take the place of a properly qualified engineer. We must use our common sense and also the extensometer in some cases. In fact, I am inclined to believe the suggestion of a French engineer some years ago has a great deal in it. He suggested that figures should be almost thrown to the wind and the extensometer rule with regard to every stress.

With regard to bridges on the Canadian Pacific, we have adopted such stresses as these certainly over twenty years ago and have had no reason to regret it. Of course, they are well inspected and frequently, and any members that have been deformed by physical injury are watched especially. I know it develops on the shoulders of one man eventually to call a halt and to make such a report to the management as will force the overloaded spans to be replaced and that item is very important. The personality of that man will have to be of the highest order, because always there are large sums of money involved and the managements, especially in these times, do not relish the idea of spending comparatively large sums.

O. B. Robbins (I. C. C.): I find myself in close agreement with the last speaker in regard to the matter of the extensometer in computing stresses. Some years ago when I was connected with the Great Northern Railway we tested the spans in the Columbia River bridge in the state of Washington. We found our computations on the test members check closely with the extensometer test, but there were other members where we found stresses far greater than we had anticipated. This illustrates the fact that the computations do not take into account within several thousand pounds to the square inch the stresses that may be developed.

Chairman Sibley: Article 7 provides for limiting the speed of trains (reads article).

Mr. Loweth: Is there any such thing as an absolute control of speed?

Chairman Sibley: The committee thinks there is in the sense used here. There are places where physical conditions as to site limit the speed and there are other conditions where an operating control that is practical certainly may be secured, but we do not want to go on record as advocating a reduction in impact in cases where the speed is not controlled by anything better than a slow order.

Mr. Loweth: One of the speakers a few minutes ago said he felt it was desirable to have a definite unit stress which would be safe because we were not all bridge engineers, and it would be desirable if he could tell just where they would have to draw the line. I think that is just where the danger comes in. We should not go right up to the danger point, and feel that beyond that there was an absolutely dangerous condition.

The tendency with a specification of this kind, as I see it, will be to put in the drawing room these stresses and

employ a man who can compute the stresses and determine the questions which will come up and then perhaps it will be perfunctorily settled by the bridge engineer that because it does not exceed the unit stresses that are stated here that the bridge is all right. That may not occur, that may only occasionally occur, but there will be a tendency that way.

Chairman Selby: If anyone puts these rules in the drafting room and leaves them there and without any other responsibility he is doing a very unwise thing and it is certainly not the intention of the committee that the rules should be so abused.

Mr. Motley calls attention to the fact that no set of rules can take the place of the personal responsibility of the engineer.

Article 1 certainly cannot be complied with in the drafting room. In fixing the carrying capacity of any bridge for traffic, its location, design, material, workmanship, behavior and physical condition must be taken into account. No one can tell in the drafting room what the behavior of the bridge is.

Prof. W. N. Wilson (U. of Ill.): The discussion of the rating of old bridges has centered, to a considerable extent, at least, in the written discussion, on the life of the bridge under these high stresses. We seem to be pretty much in accord that for a comparatively short time at least the steel structure can be subjected to stresses of 24,000 to 26,000 lb. without danger of bending, but the question in which we are interested is how long the bridge will continue in service under these excessive stresses. Our work on fatigue of metals, I think, has demonstrated that as far as the physical properties of the material itself is concerned, we have very little reason to fear that material will deteriorate. A stress of 24,000 to 26,000 lb. for steel intension is below the stress which will cause a large number of repetitions. Furthermore, I think it is our experience that where a bridge shows signs of weakening it is not because of the deterioration of the metal, but because of the working loose of the parts that are connected.

The testing work which has been done on the strength of riveted joints has demonstrated that as the stresses increase, the members that are connected slip relative to each other at a stress below the stress that was used in the design. This deformation is the slipping of one piece upon another and is not an elastic strain. We would naturally expect, then, that if this slip is repeated a large number of times that some wear will take place and the joint become loose, for, as we know, the joint holds not by virtue of the strength of the rivet in shear, but by virtue of the friction between the plates induced by the tension in the rivet.

With this idea in mind at the experiment station at the University of Illinois, we have undertaken a tentative program in which we have tried to determine the effect of repeated stresses upon riveted connections, and while we do not feel that these tests have been carried on far enough to prove anything definitely, I would like to present to the Association some of the indications of our tests.

We find that repeated stresses, in which the stress is only one-half as great as the A. R. E. A. specifications permit in design, that the rivets will work loose if the stress is repeated.

In the new specifications for new bridges it is proposed to increase the allowable stress on rivets approximately 80 per cent. The tests which we have made indicate that such a stress as that will loosen a rivet in a few hundred reversals, so that the passing of the trains for a period of 1 or 2 or 3 years will cause the rivets to work loose, and in the rating of the old bridges I think we should

focus our attention upon the effect of the over stresses upon the rivets rather than upon the material itself.

Albert Reichmann (Amer. Bridge Co.): There are several points which were brought out in the discussion on these specifications. Mr. Loweth thought that it was undesirable to fix an upper limit for refiguring old bridges. I do not agree with Mr. Loweth on that point. I think the best thing to do is to fix an upper limit and if the chief engineer or the bridge engineer of a larger system feels that he does not like to go to that upper limit, I think he could easily inaugurate a rule in his own office which would require his people to call his special attention to any bridge which came to that limit.

F. E. Schall (L. V.): I want to say something in support of Mr. Loweth's contention. If I remember correctly Mr. Loweth presented a similar table of unit stresses 5 or 6 years ago and they were about the same limit, I believe, and evidently Mr. Loweth has felt and experienced difficulties that made him change his mind.

I feel these stresses are higher than this organization should support as a general license, and say it is perfectly safe to use bridges to that extent. It is not always possible to find the weakest point in a bridge by the inspection made.

Chairman Selby: These rules are not intended to be put out for indiscriminate use by inexperienced men. They are intended only as a guide for an experienced bridge engineer to use in passing on the safety of the bridge, and the necessity for keeping it in service. If articles 1, 2 and 14 of the rules are not strong enough on that point, it might be well to make them stronger, but it should be kept in mind all the time that there is a great deal in passing on the capacity of the old bridge besides the figuring. The figures are only one of the means used to arrive at the capacity of the bridge. The other things are the physical condition, the design, details, material and the general knowledge and judgment of the bridge engineer.

B. R. Leffler (N. Y. C.): The criticism has been made that these unit stresses are too high. I think it might be well to call attention to the secondary stresses, which usually or quite often are included in the calculation of stresses in bridges. The committee in recommending these unit stresses had in mind that every legitimate of possible stress was to be calculated. I think that in the past many of the bridges have been rated as what is known as the axial stress, but in view of the fact that the committee has distinctly stated that all stresses of whatever character are to be included, it seems to me that the so-called high unit stresses are justifiable. I think we should remember that these recommendations here are not to be thrown into the drafting room and stresses calculated and a ruling given on that perfunctory operation. The specifications distinctly call for an exercise of judgment, and it is not intended that the bridge engineers will simply take these rules and pay no further attention to the structures. They are supposed to watch the structure in the light of what they have found in the field as well as in the office. I notice that while these stresses have been criticized as being too high, no one has suggested a lower stress.

Mr. Reichmann: These specifications are drafted for structures well designed, not poorly designed, and where the structures are poorly designed these factors should be considered in going over the details and in that way these stresses should be reduced. If they figure out the various details where they find defective design these stresses should be reduced, as these stresses are intended for well designed structures.

Mr. Leffler: I think it is utterly impossible to recommend limiting stresses for poor design. If a design is

so poor that the defective details cannot be calculated, for instance, eccentric connections, unsymmetrical spacing of rivets, you must rely on your judgment anyhow.

Mr. Tinker: I think these stresses should be laid on the interpretation of the specification and the physical construction of the structure, and its behavior under traffic should be considered of greater importance than the actual figures of stress which may be computed.

As to the matter of the repetition of stresses which has been mentioned, in the case where there is a reversal of stress the majority of members in the structure will not have reversal of stress, and if they have they have been designed with that fact in mind. But they will have stress in the one direction, and I believe it is true that it will require a great many more repetitions where the stress is in one direction, and that that stress may approach considerably closer to the elastic limit than in the case where there is a reversal.

I do not feel that the stresses given here are too high if they are taken in connection with the remaining paragraphs of the specification, which I believe are fully as important as the unit stresses. I wish to refer once more to paragraph 11 and ask the committee if they would not agree to remove the paragraph, because it does open the way for a large increase over the unit stresses in the table which are more or less indefinite, and it permits

a man who might forget his structure, to carry those stresses to a point to which he should not.

I. L. Simmons (C. R. I. & P.): In regard to paragraph 11, it would seem to me that should remain. It defines and limits us in our work in the establishment of the unit stresses. The latter part of the paragraph states that the unit stresses due to dead load, live load, impact and centrifugal force alone shall not exceed those given in the unit stresses. The only thing you are allowing a unit stress for is on account of the wind load. While it is possible, it is quite improbable, that you will get a maximum live load, dead load, impact, and centrifugal force, and the maximum wind load at the same time and the paragraph is written to avoid allowing anything except the wind load.

*(The motion for the adoption and insertion in the Manual of Appendix A, as a whole, was carried.)*

Chairman Selby: Referring to Appendix C, these principles were published a year ago, submitted as information, and are now without substantial change offered as conclusions.

On behalf of the committee, I move the adoption of conclusion No. 2.

*(Motion carried.)*

*The committee will be excused with the thanks of the Association.*

## Report of the Committee on Ties

*A review of the cross-tie specifications shows that a majority of roads submitting data are adhering closely to a common standard, though none are using the present specifications of the A. R. E. A. A new set of standard specifications for cross-ties and switch-ties, which is based on the U. S. Railroad Administration specifications, is presented for adoption in place of those now in the Manual. Installation of test sections forms best method to obtain accurate data on life of ties, the installation and records being under the supervision of an experienced technical man. Comparisons on economies of different classes of ties proves difficult.*



F. R. Layng  
Chairman

*F. R. Layng is rounding out his fourth year as chairman and his tenth year as a member of the committee. He served for two years as vice-chairman prior to his appointment as chairman. He also acted as chairman of the sub-committee on substitute ties for several years, a position for which he was particularly fitted because of his extensive use of metal ties. As chairman this year he has exerted a strong influence on the standard specification for ties which is presented for adoption this year. Mr. Layng is engineer of track on the Bessemer & Lake Erie, a railroad which has placed a large number of steel ties in its tracks.*

**I**N APPENDIX A THE COMMITTEE tabulated proposed changes in definitions (omitted) and submitted new specifications for cross-ties and switch-ties.

A report on the economics and the use of various classes of cross-ties and various kinds of preservative treatment was reported in Appendix C.

Appendix D contains a report on trials of substitute ties.

### Conclusions

1. The committee recommended that the changes in the Manual in Appendix A be approved and the revised matter be substituted for the present recommendations in the Manual.

2. The committee recommended that the reports in Appendices B, C and D, and the special report in Bulletin No. 227, be received as information.

Committee: F. R. Layng (B. & L. E.), chairman; W. A. Clark (D. & I. R.), vice-chairman; W. C. Baisinger (A. T. & S. F.), F. T. Beckett (C. R. I. & P.), M. S. Blaiklock (G. T.), F. Boardman (N. Y. C.), Carl Bucholtz (Erie), W. J. Bur-

ton (M. P.), S. B. Clement (T. & N. O.), E. L. Crugar (I. C.), L. A. Downs (C. of Ga.), John Foley (P. S.), O. H. Frick (C. M. & St. P.), G. F. Hand (N. Y. N. H. & H.), R. M. Leeds (L. & N.), A. F. Maischaider (C. C. C. & St. L.), A. J. Neafie (D. L. & W.), G. P. Palmer (B. & O.), George E. Rex (Nat. Lumber & Creosoting Co.), L. J. Riegler, Earl Sullivan (B. & O.).

### Appendix A—Specifications

The committee presented the following "Specification for Cross-Ties" and "Specification for Switch-Ties" and recommended that they be adopted and printed in the Manual in substitution for the specifications approved in 1916 and appearing on pages 243 to 246 of Volume 17 of the Proceedings of the Association.

#### SPECIFICATION FOR CROSS-TIES

##### MATERIAL

**Kinds of Wood**—1. Before manufacturing ties, producers shall ascertain which of the following kinds of wood suitable for cross-ties will be accepted: Ash, Beech, Birch, Catalpa, Cedar, Cherry, Chestnut, Cypress, Elm, Fir, Gum, Hack-

berry, Hemlock, Hickory, Larch, Locust, Maple, Mulberry, Oak, Pine, Poplar, Redwood, Sassafras, Spruce, Sycamore and Walnut. Others will not be accepted unless specially ordered.

#### PHYSICAL REQUIREMENTS

**General Quality**—All ties shall be free from any defects that may impair their strength or durability as cross-ties, such as decay, large splits, large shakes, large or numerous holes or knots, or grain with slant greater than one in fifteen.

**Resistance to Wear**—Ties from needle-leaved trees shall be of compact wood throughout the top fourth of the tie, where any inch of any radius from the pith shall have not less than one-third summerwood in six or more rings of annual growth, or not less than one-half summerwood in fewer rings. Ties of coarse wood having fewer rings or less summerwood will not be accepted unless specially ordered.

**Resistance to Decay**—Ties for use without preservative treatment shall not have sapwood wider than one-fourth the width of the top of the tie between 20 in. and 40 in. from the middle, and will be designated as "heart" ties. Those with more sapwood will be designated as "sap" ties.

#### DESIGN

**Dimensions**—2. Before manufacturing ties, producers shall ascertain which of the following lengths, shapes, or sizes will be accepted, and whether ties are to be hewed or sawed and in either case whether on the sides as well as on the top and the bottom.

All ties shall be eight feet, eight feet six inches, or nine feet long.

All ties shall measure as follows throughout both sections between 20 in. and 40 in. from the middle of the tie:

Grade	Sawed or Hewed Top, Bottom and Sides	Sawed or Hewed Top and Bottom
1	None accepted	6" thick x 6" wide on top
2	6" thick x 7" wide on top	6" thick x 7" wide on top
3	6" thick x 8" wide on top	6" thick x 8" wide on top
		7" thick x 7" wide on top
4	7" thick x 8" wide on top	7" thick x 8" wide on top
5	7" thick x 9" wide on top	7" thick x 9" wide on top
6	7" thick x 10" wide on top	7" thick x 10" wide on top

#### MANUFACTURE

All ties, except those of.....  
(Specify kind or kinds of wood)  
shall be made from trees which have been felled not longer than one month.

All ties shall be straight, well hewed or sawed, cut square at the ends, have bottom and top parallel, and have bark entirely removed.

#### INSPECTION

Ties will be inspected after delivery at suitable and convenient places satisfactory to the railroad, which reserves the right to inspect ties at points of shipment or at destination. Ties will be inspected at points other than the railroad's property whenever in the judgment of the railroad there is sufficient number to warrant it; but the shipper shall provide accommodations for the inspector while away from rail or steamer lines and transport him from or to a railroad station or steamer landing.

Inspectors will make a reasonably close examination of the top, bottom, sides, and ends of each tie. Each tie will be graded independently without regard for the grading of others in the same lot. Rafted or boomed ties too muddled for ready examination will be rejected. Ties handled over hoists will be turned over as inspected.

Ties will be rejected when decayed in the slightest degree, except that the following will be allowed: in cedar, "pipe or stump rot" up to 1½ in. in diameter and 15 in. deep; in cypress, "peck" up to the limitations as to holes; and, in pine, "blue sap stain."

A large hole in woods other than cedar is one more than ½ in. in diameter and 3 in. deep within, or more than 1 in. in diameter and 3 in. deep outside the sections of the tie between 20 in. and 40 in. from its middle. Numerous holes are any number equalling a large hole in damaging effect. Such holes may result in manufacture or otherwise.

A large knot is one exceeding in width more than ¼ of the width of the surface on which it appears; but such a knot may be allowed if it occurs outside the sections of the tie between 20 in. and 40 in. from its middle. Numerous knots are any number equalling a large knot in damaging effect.

A shake is a separation of one ring of annual growth from another. One which is not over 4 in. long or ¼ in. wide will be allowed.

A split is a break across annual rings. One which is not

over 10 in. long will be allowed provided a satisfactory anti-splitting device has been properly applied.

A tie will be considered straight: (1) When a straight line along the top from the middle of one end to the middle of the other end is entirely within the tie; (2) when a straight line along a side from the middle of one end to the middle of the other is everywhere more than 2 in. from the top and the bottom of the tie.

A tie is not well hewed or sawed when its surfaces are cut into with scoremarks more than ½ in. deep or when its surfaces are not even.

The lengths, thicknesses and widths specified are minimum dimensions. Ties over 1 in. more in thickness, over 3 in. more in width, or over 2 in. more in length will be degraded or rejected.

The top and bottom of a tie will be considered parallel if the difference in the thickness at the two sides or ends does not exceed ½ in.; that is, one side may be 7¼ in. while the other is 6¾ in. wide; or one end may be 6¾ in. while the other is 7¼ in. thick.

All thicknesses and widths apply to the sections of the tie between 20 in. and 40 in. from the middle of the tie. All determinations of width will be made on the top of the tie, which is the narrower of the horizontal surfaces.

Ties which are oversize will be accepted as follows: 8 in. to 9 in. by 9 in. to 12 in. as Grade 4; 9 in. to 10 in. by 9 in. to 12 in. as Grade 3. Ties over 10 in. thick or over 12 in. wide on top will be rejected. Ties will be graded up by their smaller ends and graded down by their larger ends. The dimensions of the tie will not be averaged.

#### DELIVERY

All ties, except those of.....  
(Specify kind or kinds of wood)

shall be delivered to the railroad within one month after being made.

Ties delivered on the premises of the railroad for inspection shall be stacked not less than 10 ft. from the nearest rail of any track at suitable and convenient places; but not at public crossings, nor where they will interfere with the view of trainmen or of people approaching the railroad. Ties shall be stacked in alternate layers of two and seven, the bottom layer to consist of two ties kept at least six inches above the ground. The second layer shall consist of seven ties laid crosswise of the first layer. When the ties are rectangular, the two outside ties of the layers of seven and the layers of two shall be laid on their sides. The ties in layers of two shall be laid at the extreme ends of the ties in the layers of seven. No stack may be more than 12 layers high, and there shall be five feet between stacks to facilitate inspection. Ties which have stood on their ends on the ground will be rejected.

Each stack shall have fastened to it a tag on which is written the owner's name and address, the date when stacked, and the number of ties of each kind of wood in the stack.

All ties are at the owner's risk until accepted. All rejected ties shall be removed within one month after inspection.

Ties shall be stacked as grouped below. Only the kinds of wood named in a group may be stacked together.

#### CLASS U—TIES WHICH MAY BE USED UNTREATED

GROUP UA	GROUP UB	GROUP UC	GROUP UD
"Heart" Black Locust	"Heart" Douglas Fir	"Heart" Cedars	"Heart" Catalpa
"Heart" White Oaks	"Heart" Pines	"Heart" Cypress	"Heart" Chestnut
"Heart" Black Walnut		"Heart" Redwood	"Heart" Red Mulberry
			"Heart" Sassafras

#### CLASS T—TIES WHICH SHOULD BE TREATED

GROUP TA	GROUP TB	GROUP TC	GROUP TD
Ashes	"Sap" Cedars	Beech	"Sap" Catalpa
Hickories	"Sap" Cypress	Birches	"Sap" Chestnut
"Sap" Black Locust	"Sap" Douglas Fir	Cherries	Elms
Red Oaks	Hemlocks	Gums	Hackberry
"Sap" White Oaks	Larches	Hard Maples	Soft Maples
"Sap" Black Walnut	"Sap" Pines		"Sap" Mulberries
	"Sap" Redwood		Poplars
			"Sap" Sassafras
			Spruces
			Sycamore
			White Walnut

#### SHIPMENT

Ties forwarded in cars or vessels shall be separated therein according to the above groups, and also according to the above sizes if inspected before loading.

#### SPECIFICATION FOR SWITCH-TIES

##### MATERIAL

**Kinds of Wood**—1. Before manufacturing ties, producers shall ascertain which of the following kinds of wood suitable for switch-ties will be acceptable: Ash, Beech, Birch, Cedar,

Cherry, Chestnut, Cypress, Fir, Gum, Hemlock, Larch, Locust, Maple, Oak, Pine and Redwood. Others will not be accepted unless specially ordered.

#### PHYSICAL REQUIREMENTS

**General Quality** [same as for cross-ties].

**Resistance to Wear** [same as for cross-ties].

**Resistance to Decay**—Ties for use without preservative treatment shall not have sapwood wider than one-fourth the width of the top between 12 in. from each end of the tie, and will be designated as "heart" ties. Those with more sapwood will be designated as "sap" ties.

#### DESIGN

**Dimensions**—2. Before manufacturing ties, producers shall ascertain what sizes of ties will be acceptable and whether ties are to be hewed or sawed and in either case whether on the sides as well as the top and the bottom.

All ties shall be 7 in. thick.

Ties sawed or hewed on top, bottom, and sides shall be not less than 9 in. wide on top throughout the section between 12 in. from each end of the tie. Ties sawed or hewed on top and bottom only shall be not less than 7 in. wide on top throughout the section between 12 in. from each end of the tie.

Each tie shall be of a length specified below:

(Bill of Material)

1. It is expected that each railroad will specify only the kind or kinds of wood it desires to use.
2. It is expected that each railroad will specify only the shape or shapes and size or sizes it desires to use.

#### MANUFACTURE

[Clause same as for cross-ties.]

#### INSPECTION

[All paragraphs same as for cross-ties except the one given below.]

A large knot is one exceeding in width more than one-quarter ( $\frac{1}{4}$ ) of the width of the surface on which it appears; but such a knot may be allowed if it occurs outside the section between twelve (12) inches from each end of the tie.

#### DELIVERY

All ties, except those of.....  
(Specify kind or kinds of wood)

shall be delivered to the railroad within one month after being made.

Ties delivered on the premises of the railroad shall be stacked not less than 10 ft. from the nearest rail of any track at suitable and convenient places; but not at public crossings, nor where they will interfere with the views of trainmen or of people approaching the railroad. Ties shall be stacked at least 6 in. above the ground. No tie shall be unsupported for more than 10 ft. of its length. The ties in each layer of 10 or more shall be not less than 1 in. apart, and such layers shall be separated by stacking strips at least 1 in. thick and not more than 4 in. wide. If ties are used to separate the layers of 10 or more, and they are rectangular, such strip ties shall be laid on their sides and the 2 outside ties as near as possible to the extreme ends of the ties in the layers of 10 or more. No ties shall be permitted to overhang more than 2 ft. No stack of ties shall be wider than 10 ft.

Each stack shall have fastened to it a tag on which is written the owner's name and address, the date when stacked, and the number of ties of each kind of wood in the stack.

All ties are at the owner's risk until accepted. All rejected ties shall be removed within one month after inspection.

Ties shall be stacked as grouped below. Only the kinds of wood named in a group may be stacked together.

#### CLASS U—TIES WHICH MAY BE USED UNTREATED

GROUP UA	GROUP UB	GROUP UC	GROUP UD
"Heart" Black Locust	"Heart" Douglas Fir	"Heart" Cedars	"Heart" Chestnut
"Heart" White Oaks	"Heart" Pines	"Heart" Cypress	
		"Heart" Redwood	

#### CLASS T—TIES WHICH SHOULD BE TREATED

GROUP TA	GROUP TB	GROUP TC	GROUP TD
Ashes	"Sap" Cedars	Beech	"Sap" Chestnut
"Sap" Black Locust	"Sap" Cypress	Birches	Soft Maples
Honey Locust	"Sap" Douglas Fir	Cherries	
Red Oaks	Hemlocks	Gums	
"Sap" White Oaks	Larches	Hard Maples	
	"Sap" Pines		
	"Sap" Redwood		

#### SHIPMENT

Ties forwarded in cars or vessels shall be separated therein according to the above groups, and also according to the above sets or lengths if inspected before loading.

## Appendix B—Methods of Installing and Keeping Records of Test Sections

The Association has decided that the method of test sections is the best way to obtain the necessary data. The methods of installing the test sections and of collecting and reporting the data on different railroads are not uniform, although the work of the Forest Products Laboratory has tended toward uniform methods of reporting.

The principal criticism of the test section method of obtaining data on tie life has been that it often gave abnormal results. This criticism, if merited, is probably due to the fact that the ties are in most cases selected, the maintenance is above the standard, and the renewals are watched with unusual care. The main object of the tests is comparative data, however, and the test sections as usually installed give this comparison, but it is believed that the tests might be made more nearly representative if care were taken to keep the conditions as near as possible to average actual practice.

Of 40 railroads canvassed by this sub-committee, only five submitted data to show that a systematic record of test sections had been kept; namely, the Chicago, Burlington & Quincy, the Great Northern, the Baltimore & Ohio, the Pennsylvania and the Northern Pacific. Several other roads are keeping a more or less complete and comprehensive record of this kind.

#### RECOMMENDATIONS

**Installing Test Sections**—(1) In locating test sections, it is of first importance that a piece of track be selected that has no switches and is not likely to be disturbed by new construction or abnormal rail renewals. It is not essential but it is recommended that the test ties all be put in at once "out of face," as this accelerates the gathering of the information and without greatly increasing the ex-

NORTH & SOUTH RAILROAD									
INSPECTION OF EXPERIMENTAL TIES									
Location.....									
Between M. P..... and M. P.....									
Date Placed in Track.....									
Tie No.	Condition When Laid	Condition at Date of Inspection							
1									
2									

Form for Report on the Condition of Each Tie

pense, as the good ties removed can be used elsewhere. All of the different kinds of ties in a test section should, so far as possible, be installed under the same conditions of curvature, grade and drainage. The committee recommends that not less than 100 ties of each kind under test be installed. If installed in multiples of 100, the percentages are readily obtained. If too few ties are put in, a few abnormal failures may make the test misleading. Each tie should be numbered and most roads think it necessary to mark each tie with its number, and in some cases with kind of timber and date of insertion. If a reliable record is kept in the office, however, it scarcely seems necessary to mark the tie with more than its number. The test sections should be marked by suitable monuments at each end.

**Inspection of Test Tracks**—(2) It is recommended that installation and records of the test sections be under the supervision of a technical man, experienced in that kind of work, who is qualified to make accurate observations and keep good records, so that the tests will be continuous and not affected by changes in the personnel. Regular inspection should be made of the test sections at least once a year. Ties should not be removed except in

emergencies without the approval of the official responsible for the record and should never be destroyed until inspected by him or his representative.

**Tie Record**—(3) The essentials of the record are covered by two forms: one being a report (Form No. 1) giving the location and principal data, such as traffic, weight of rail, kind of ballast, kind of tie, treatment, etc., and the other a record of the inspections (Form No. 2) showing the condition of each tie at each inspection. If many kinds of ties are under test in the test sections, a chart showing the location of the different kinds will be helpful and it is necessary to have a full record of the treatment of each different lot of ties under test.

In case the ties in the test sections are not put in "out of face," but the existing ties in the track are considered as test ties, the forms must be modified accordingly. Or if the test sections are to be built up by keeping a record of the ties used in renewals, still different forms are needed.

As renewal "out of face" is recommended in installing test sections, only the one set of forms is offered, though it is agreed that reliable records can be secured by any one of the three methods.

Form No. 1

#### NORTH & SOUTH RAILROAD REPORT OF EXPERIMENTAL TEST TIE SECTIONS

District.....Division.....  
Location.....  
Kind of Ballast.....  
Tangent or Curve %.....  
Tie Plates.....  
Weight of Rail.....  
Rail Fastenings.....  
Rail Changed When.....  
Weight of Rail Originally in Track.....  
Size of Ties.....  
Kind of Timber.....  
Where Treated.....  
When Treated.....  
How Treated.....  
When Put in Track.....  
Number Originally Put in Track.....  
Number Still in Track Last Inspection.....  
When Last Inspected.....  
Traffic.....  
Remarks:

#### Appendix C—The Economics of the Use of Various Classes of Cross-Ties and Various Kinds of Preservative Treatment

An investigation of existing data indicates that not only is satisfactory tie life data far from plentiful, but also that much of it has been obtained, primarily for the purpose of justifying treatment and without very much regard to the question of size of tie or kind of wood. Some of the more recent tie data is one-sided, in that certain variables, especially the treatment details, are recorded with particularity out of proportion to the provisions for other equally important or even more important variables.

Some of the many variables which influence the life of ties are: Kind of wood, dimensions, preservative treatment, ballast, fastenings, climate and traffic. Wrong conclusions might easily be drawn if these variables are based on present data exclusively.

Having in mind this incomparability of much of the limited data existing, as well as to elicit discussion, the committee sent out a questionnaire dealing with the subject, and asking for opinion data where actual results were not available. It would seem from the returns that in some cases "conventional" ideas as to life of ties of certain kinds are reported, and it is also apparent that the variable of traffic, which is very difficult to handle, must receive much greater attention before proper comparisons or conclusions may be made.

A tabulation of the replies shows that, without taking

into account such variables as traffic and climate, conclusions, as, for instance, between ties seven inches thick compared with those six inches, are out of the question.

In view of the lack of data and the conflicting ideas, the committee desires to report progress on the subject, but to draw no conclusions this year. The information in the exhibits is presented as having value in considering the subject.

#### Discussion

F. R. Layng (B. & L. E.) (Chairman): The first subject to be presented will be the revision of the Manual, which will be given by Mr. Foley, the chairman of this sub-committee.

John Foley (Penna.): Appendix A comprises recommendations of the Committee in connection with the revision of the Manual. They are mostly additions with a few corrections and some omissions.

The Chairman: The chairman suggests that opportunity be given for discussion of that portion of Appendix A, down to the word "Specifications."

Chairman Layng: I move that that portion of the Revision of Manual, shown under Appendix A down to "Specifications," be adopted for printing in the Manual. (Motion carried.)

Mr. Foley: The several tables following Appendix A is the summarized form of the material which was gathered by the committee in its consideration of a specification for cross-ties. The chairman calls attention to the fact that the committee was guided by the standard form adopted by the Board of Arbitration, which resulted in a slight rearrangement of this specification. The whole chapter on inspection is a development in the matter of specifications for cross ties, and brings to the manufacturer as well as to the railroad the standard practices which have developed in recent years.

In the ninth paragraph of the matter on Inspection, the committee has the following substitution to recommend: The lengths, thicknesses and widths specified are minimum dimensions. Ties over 1 in. and under 2 in. or more in thickness than the maximum specified will be accepted as one grade below the largest tie specified. Those 2 in. to 3 in. more in thickness than the maximum specified will be accepted as two grades below the largest tie specified. Those over 3 in. more in thickness or width of over 2 in. more in length than the maximum specified, will be rejected. Ties will be graded up by their smaller ends and graded down by their larger ends. The dimensions of the tie will not be averaged.

This does not alter the specification as you have it, but expresses it in a clearer form. It also makes it possible to apply the last paragraph to ties which may be ordered by a railroad that objects to purchasing grades larger than grade 3. As it is in the printed report, a railroad that stopped at grade 3 or grade 4 would not be able to apply this without certain alterations.

W. G. Arn (I. C.): In this paragraph on resistance to wear, what are we to do in the case where a railroad uses loblolly and woods of that kind quite extensively?

Mr. Foley: You will note that the specification does not bar the acceptance of a tie that any railroad might feel that it can accept.

Mr. Lewis: Under the head of "kinds of ties"—kinds of woods, rather—I wonder why the committee adopted that rather negative expression instead of saying: "Cross ties of the following kinds of woods will be accepted."

Mr. Foley: The committee figures that this is a general specification of ties which is going to be circulated. Some railroads which buy over a very large territory will not wish their specification to get into the hands of the manufacturer of ties, for he, without any consultation

with the railroad, might begin the manufacture of them, and end up by finding that some of the kinds of wood which he had in his timber land, and which he converted into ties, are not readily salable. We want it so that the manufacturer will find out from the railroad what it is they desire.

E. A. Frink (S. A. L.): Mr. Chairman, I would like to call the attention of the committee that we have this year presented to us three classifications for ties, this present one, two by the Committee on Wooden Bridges and Trestles, covering bridge ties and sawn ties and guard rails. It seems to me that these specifications should be made to harmonize before they are presented.

Chairman Layng: The committee felt it was certainly not the province of that committee to present specifications for either cross ties or switch ties. We feel that it is the duty of this committee to handle that, and if they have presented a specification we feel that they should withdraw it.

Mr. Foley: The committee felt that since switch ties were used as are cross ties, the specification should correspond as far as conditions would allow, and in that they followed the practice which was made standard in 1915, 1916 and 1917. Again, the specification follows the standard that is adopted by the Board of Direction.

(Mr. Foley gave the specification for switch ties.)

Chairman Layng: *I move the adoption of these specifications for cross ties and the specification for switch ties for printing in the Manual.*

(Motion carried.)

Chairman Layng: The next subject is shown in Appendix B, which will be presented by W. A. Clark, chairman of the sub-committee.

W. A. Clark (D. & I. R.): A year ago the Association approved of the test section method of collecting data on the life of cross ties. This committee was asked to report on methods of installing and keeping records of test sections. It developed from the information received by the committee that while many roads have installed test sections, there is no uniform method adopted for installing or keeping the records. With a view of promoting uniformity the committee had formulated the recommendations presented.

F. J. Angier (B. & O.): I suggest that in Form No. 1 the committee leave a line there for the average annual rainfall. It seems to me this is a factor that should be considered in any test tie section.

The Chairman: The committee say they will take that suggestion under consideration.

(Appendices C and D were next presented for the information of the Association, following which the committee was dismissed with the thanks of the Association.)

## Report on Signs, Fences and Crossings

*Revision of specifications for standard right-of-way fences is presented in order to make such fencing conform to the law in a large number of states. Old recommendations as to galvanizing are found impracticable when applied to manufacturing processes. Additional standards for signs for the use and information of railway employees are submitted for inclusion in the Manual. A valuation section sign is recommended on account of the valuation by the government and the probable continuation of reports by valuation sections. Regulations as to grade crossings already in effect in various states and Canada are presented. Wood plank is recommended for grade crossing construction.*



Arthur Crumpton  
Chairman

*Arthur Crumpton has been a member of the committee for eight years, and served as vice-chairman for three years prior to his appointment as chairman two years ago. Through his active participation in the work of this committee he has rendered an important service to the railways through the development of a series of standard signs to replace the innumerable designs now in use over the country. As valuation engineer of the Grand Trunk, which has been taken over recently by the Canadian Government, he is now in the anomalous position of working under the direction of the United States Division of Valuation, in so far as the mileage in this country is concerned.*

IN APPENDIX "A" are given proposed changes in the Manual, together with the reasons therefor, and its recommendations are given under the heading of Conclusions. In Appendix "B" the committee submits the results of its review of various signs. Its recommendations are given under the heading of Conclusions. In Appendix "C" the committee submits the results of its studies on highway crossing protection. This includes an abstract of laws on this subject in the United States and Canada (omitted).

### Conclusions

(1) The committee recommended that the changes in the Manual in Appendix "A" be approved.

(2) The committee recommended that the following paragraphs be approved and published in the Manual at the bottom of page 316 in lieu of its recommendation adopted at the last convention. The additional signs

covered are End of Block, Lack of Clearance, Corporation or Sub-division and Passing Siding.

### ROADWAY INFORMATION SIGNS

Signs for Dump Ashes, Blind Siding, Water Station, Fuel Station, Beginning of Double Track, End of Double Track, End of Block, Lack of Clearance, Corporation or Sub-division and Passing Siding to be similar to sketch shown on page 318, 1915 Manual, for Trespass Signs.

Length of sign plate to be changed, if necessary, on account of wording, and corners to be square on last two signs.

The committee recommended that the designs submitted of Mile Post, Section Sign, Sub-division and Section Sign, Property Post, Bridge Number, Curve and Elevation, Number and Valuation Section signs be approved and published in the Manual.

Committee: Arthur Crumpton (G. T.), chairman; Maro Johnson (I. C.), vice-chairman; Arthur Anderson (N. Y. C.),

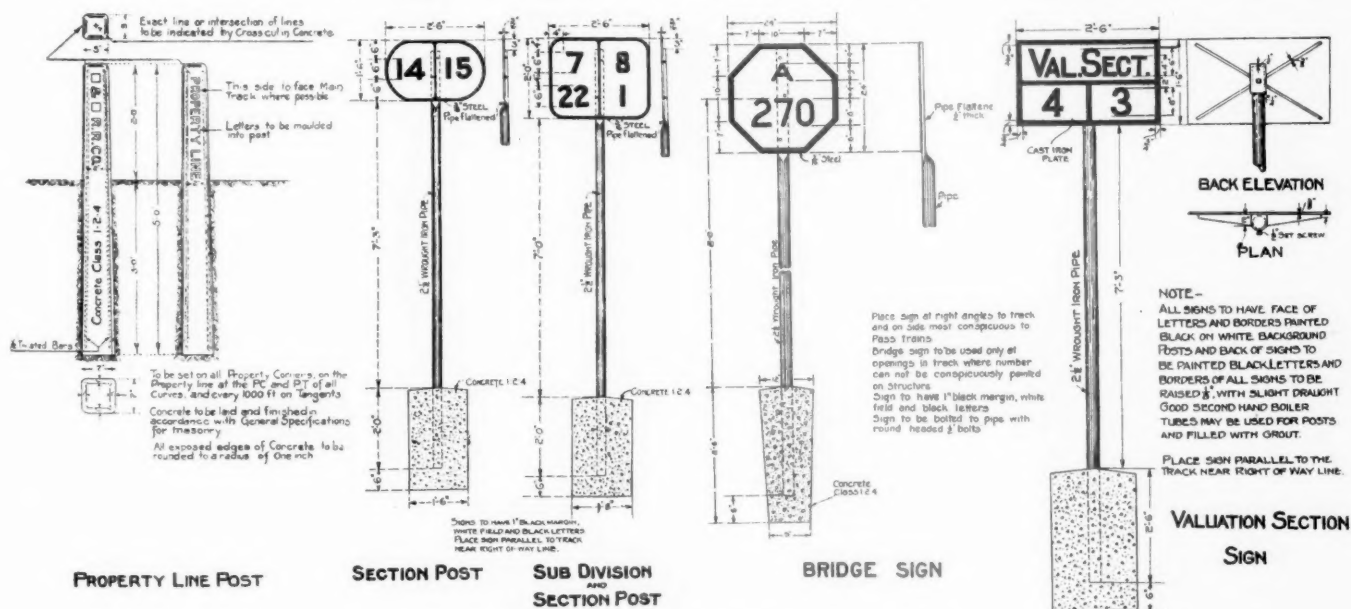
F. W. Bailey (S. A. & A. P.), F. D. Batchellor (B. & O.), F. T. Darrow (C. B. & Q.), G. N. Edmondson (N. Y. C.), S. C. Jump (I. C.), L. C. Lawton (A. T. & S. F.), S. L. McClanahan, W. S. McFetridge (B. & L. E.), L. A. Mitchell (Un. Tr.), T. E. Rust (C. F. & N.), W. D. Warren (N. Y. N. H. & H.), K. G. Williams (Union), D. R. Young (D. L. & W.).

### Appendix A—Revision of Manual

#### SPECIFICATIONS FOR STANDARD RIGHT OF WAY FENCES

**Class A Fence.**—A fence 4 ft. 6 in. high is required by the laws of a great many states. The specifications as they now appear in the Manual provide that when this fence is used for hogs the bottom wire shall be not over 3 in. above the ground with a strand of barbed wire below. This would make the fence only 4 ft. 4 in. high, which would prevent its use in states requiring a 4 ft. 6 in. high fence. The sub-committee believes that the use of a barbed wire  $2\frac{1}{2}$  in. below the fencing will serve the purpose without lowering the woven wire.

**Class B Fence.**—A change from stays 18 in. apart to 12 in. apart is recommended because our largest makers of woven wire fencing do not fabricate this fence with



Recommended Designs for Inclusion in the Manual

18-in. stays. It is also our opinion that the use of 12-in. stays is fully warranted.

**Class C Fence.**—The Class C fence specified in the Manual is one that is only suitable under special conditions and in special locations. A fence 3 ft. 6 in. high is not suitable for general use, would be a legal stock fence in few, if any, states, and when used should be so placed as to suit the special conditions which caused its adoption. In its place the sub-committee has recommended a fence which is being used to some extent and which gives most of the advantages of the Class A fence at a considerably lower cost.

**Concrete Posts.**—The specifications for concrete posts, paragraphs 10, 11, 12 and 13 and the last sentence of paragraph 24, are obsolete, being largely amended by the conclusions adopted by the Association in 1918. Inferentially, also, they exclude the use of steel posts which have been adopted by several roads. The sub-committee thought it best, therefore, to omit all reference to concrete posts. Later on, if thought best, specifications of fence with concrete posts and with steel posts can be prepared by the committee.

**Intermediate or Line Posts.**—The present specifications

for line posts provide that they shall be  $16\frac{1}{2}$  ft. apart, without any reference to a short panel at the corners or ends. The sub-committee believes that a shorter panel should be used at these corners and ends and recommends 10 ft. If this panel is too long an unnecessarily heavy brace is required and if it is too short there is a tendency for the end post to lift out of the ground. Ten feet is thought to be about the right length. The change in the distance apart of other line posts to "not more than 20 ft." is to meet the practice of those roads which use 20-ft. centers, and, apparently, with good results.

**Stretching.**—The sub-committee is of the opinion that on curves it is desirable to have the fence on the outside of the curve from the posts so that the fence pulls against the posts instead of away from them. If this is not done it is thought that the staples would be likely to pull out when the wood in the post gets old and loses its holding power.

**Splicing.**—The sub-committee recommends the omission of the last two sentences advocating smooth wire, as it seems to us that while the use of smooth wire may be proper in some places it certainly is not desirable in

all places. On the western plains, for instance, smooth wire would scarcely be suitable for cattle fences.

#### GALVANIZED WIRE FENCING

The committee recommended that the two paragraphs on page 303 of the Manual headed Galvanized Wire Fencing be omitted.

#### Appendix B—Signs

The following is a resumé of the various signs, together with recommendations for their use. Signs should be divided between those serving the public and those serving employees, the latter of course being largely in the majority.

The first signs are those serving the public:

**Highway Crossing Signs.**—(a) At crossings. (b) Approach warning signs. The first sign, "at crossings," is covered in the 1915 Manual, page 317. The second sign, "approach warning signs," was adopted by the convention at its 1920 session.

**Trespass Signs.**—(a) Right-of-Way. (b) Bridge. (c) Crossing. These are covered on page 318 of the 1915 Manual.

**Private Crossing Sign.**—The committee does not believe a sign should be adopted by the Association to cover this, but considers it entirely a local matter as to their use.

The following signs are for the use of railroad employees:

**Yard Limit**—This is covered in Supplement to the Manual issued in 1918, pages 53 to 63.

**Speed Limit**—Permanent. Temporary. (a) Limit. (b) Slow. (c) Resume. This is also covered by the above reference to Supplement and to the Manual, no distinction being made, however, between permanent and temporary signs and the "b" sign covered by a note.

**Railroad Crossings**—(a) Distant (1 mile). (b) Close (Stop or 400-ft. sign). This is covered as above by 1918 Supplement to the Manual, pages 53 to 63, as far as the "one mile" sign is concerned, but nothing was ever done with regard to the sign used by many railroads close to the crossing.

**Junction—1 mile.**

**Yard—1 mile.**

**Station—1 mile.**

**Whistle Post**—Covered by the 1918 Supplement to the Manual.

**Drawbridge**—(a) Distant (1 mile). (b) Close.

The "one mile" sign was adopted in the 1918 Supplement to the Manual. Nothing, however, was adopted for the "close" sign to a drawbridge which is used the same as at railroad grade crossings.

**Flanger Sign**—Adopted in the 1918 Supplement to the Manual.

**Water Station Limit.**

**Fuel Station Limit.**

**Cinder Station Limit.**

**Blind Siding.**

**Beginning and End of Double Track.** Adopted at the 1920 convention, similar to sign on page 318 of the Manual.

The above cover all signs that have been adopted by the Association to date. The following signs are still left for consideration:

**End of Block**—The committee recommends that this sign be similar in design to the sign adopted at the 1920 convention for the Beginning and End of Double Track.

**Clearance Post**—The committee recommends that no such post be adopted.

**Mile Post**—The committee presents design of mile post, which they recommend for adoption.

**Section Signs—Sub-Division and Section Signs**—The committee submits sketches herewith.

**Corporation or Sub-Division Signs**—The committee recommends that this be similar to sign on page 318 of the Manual, excepting that it would be necessary to use a sign either 36 ft. x 24 ft. or 42 ft. x 24 ft.

**Property Posts**—The committee submits a sketch for adoption.

**Passenger Station and Passing Siding Signs**—The committee believes that passenger station signs are not properly roadway signs. For passing siding signs the committee recommends one similar to sign on page 318 of the Manual.

**Track Pan Posts**—The committee understands that this matter is being considered by the Signal Committee, as shown on page 77 of Volume 19 of the Proceedings of the Association.

**Bridge Numbers**—The committee submits herewith sketch of a proposed sign to be used at bridges where the numbers cannot be painted directly on the structures.

**Culvert Numbers**—The committee recommends that no sign be adopted for culvert numbers, as this would require in many cases a large number of unimportant signs.

**Curve and Elevation Numbers**—The committee submits a sketch.

**Lack of Clearance Sign**—The committee recommends a sign of this kind be constructed similar to sign shown on page 318 of the Manual, with the proper wording.

**Valuation Section Sign**—If such sign is desired, the committee recommends the adoption of sketch submitted.

### Appendix C—(3) Highway Crossings

Grade crossings have taken on greatly increased importance during recent years. State and local authorities have become interested and in many cases are actively co-operating in providing protection, in improving the physical conditions and in educating the public. Some states have laws with definite requirements as to grades to be used and details of construction. In others the highway commission has adopted rules pertaining to these features.

The report of the committee included an abstract of

the regulations in effect in the various states and Canada. In general, these regulations are interpreted in a liberal spirit by the officials enforcing them. For highways where the requirements are not stipulated by law the following specifications, which it is believed will provide an adequate crossing, are presented as information with a view to their consideration at a later date for insertion in the Manual.

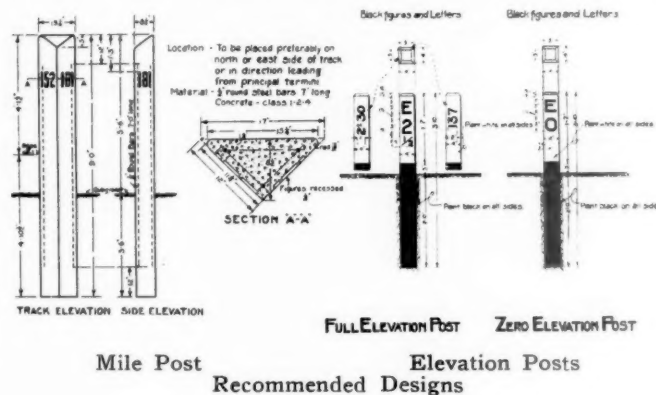
Wood plank are recommended. Some roads are using concrete plank experimentally and others, bituminous concrete, at crossings. This committee is not ready to recommend these.

### SPECIFICATIONS FOR HIGHWAY CROSSINGS

(1) A railroad grade crossing should not be so constructed that it will limit the traffic on a highway in respect to number of vehicles or load carried by them.

(2a) Under ordinary conditions the grade of the surface of the highway should be level with the top of rail for a distance of 1 ft. outside each rail; should be 3 in. lower at points 10 ft. each side of the center of the track, and should slope upward or downward from these 10-ft. points at grades not exceeding 5 per cent, where such grades are practicable.

(2b) Where the length of the approach is excessive, where the view is obstructed, or where an approach grade in excess of 5 per cent is necessary, the following grade line should be used: The surface of the highway should be level with the top of rail, for a distance of 1 ft. outside each rail; should



be 6 in. lower at points 30 ft. each side of the center of the track, and should slope upward or downward from these 30-ft. points, at grades not exceeding 5 per cent, where such grades are practicable.

(3) The width of embankment at the crown end of cuts, exclusive of ditches, should be not less than 20 ft.

(4) Ample drainage for railway and highway should be provided.

(5) A single line of 4-in. plank not less than 10 in. wide and 16 ft. long, measured at right angles to the highway, should be placed outside and adjacent to each rail. The space between the rails should be planked solid after making provision for flangeways. The top surface of plank should not be more than 1/4 in. below the top of rail, and should be chamfered at each end. Flangeways should be 2 1/4 in. wide and tapered to 4 in. at the extreme ends. Rail joints should not come within the limits of the planking except where the length of crossing exceeds the length of rail.

### CROSSING GATES—WARNING SIGNALS AND BELLS

This Association has adopted a standard highway crossing sign, page 317 of the Manual, and a standard approach warning sign, page 629, Vol. 21 of Proceedings. The approach warning sign has been adopted by the National Association of Railroad Commissioners and by the American Railway Association. In some states a stop sign consisting of a semi-circular metal plate with the word "stop" is located close to the track at crossings designated by the public service commission or other authority. Under all ordinary conditions these signs are all the protection required.

The use of crossing gates, warning signals and bells should be confined to crossings in cities and towns where

the view is obscured or highway and rail traffic is heavy. Their use elsewhere is not ordinarily justified. Where a flagman is on duty bells should not be installed. There is a tendency for the flagman to depend on the bell.

Mechanically operated gates are simple and easy to maintain. The pneumatic gate is also satisfactory. Both types are subject to some trouble in the winter time. Pneumatic gates are adapted to situations where more than one pair of gates are operated from the same gate house. Such installations should be made where the gateman has a full view of both crossings. Electrically operated gates are more expensive in first cost, in maintenance and in operation. The use of automatic electric gates actuated by approaching trains through a track circuit is not desirable. It should be possible to operate gates on opposite sides of the track independently. It requires about 20 sec. to operate one pair of gates. The crossing should be closed about  $\frac{1}{2}$  min. in advance of the arrival of train. Striped gate arms are more easily seen than those painted in solid color.

Wigwags should be visible 500 ft. from the track. Bells should be loud enough to be heard above the noise of trains. Either device should be operated not less than  $\frac{1}{2}$  min. in advance of arrival of train. The length of track circuit will vary with the grade and with operating conditions. On double-track lines operation of warning devices is usually in the normal direction only.

Wigwags should be positive in action. The arrangement should be such that, when in working order, the disc will be concealed except when a train is approaching. When the device is out of order the disc should be in full view. Bells striking intermittently are more effective than those ringing continuously.

#### Discussion

Arthur Crumpton (G. T.), Chairman: In Appendix A the committee submit proposed changes in the Manual, together with the reasons therefor, and I will ask Mr. Rust, Chairman, to present the report.

T. E. Rust (W. C. F. & N.): Your committee, somewhat against its inclination, has recommended quite a number of changes in the Manual.

(Mr. Rust submitted Appendix A) and said:

"(3) The Sub-Committee recommends that the two paragraphs on page 303 of the Manual headed Galvanized Wire Fencing, be omitted."

In the first place they are rather conflicting. In one case they say that an electrically welded fence should be regalvanized after fabrication, and in the second place they say it should be galvanized after fabrication. The second paragraph also says that only wire of the specification of the Association should be used in the fences. That part of it, it seems to me, is entirely unnecessary. The adoption of the specification carries with it the recommendation that it should be used.

As to the regalvanizing of woven wire fencing, it is felt that this is impractical. In the first place, when the wire is to be coated with spelter, it is drawn through the bath and it will acquire the temperature of the spelter before it leaves the bath. If that is done, obviously the spelter which is first put on the wire will be melted off during its progress through the bath, and no more spelter will remain on the wire than remained after the first immersion. In the second place, wire metal which has been exposed to the atmosphere even for a few moments slightly oxidizes, and in order to be properly coated with zinc it is necessary that it should be chemically clean. There is no known method of chemically cleaning wire after it has been once zinc coated so that it will take a second zinc coat.

As to galvanizing after fabrication, I think that if the

members will consider what the result would be, even if such a process were practical, they would not desire to have a fence that had been regalvanized after fabrication. Large knots of spelter would unquestionably accumulate at the junction of the wires, and when the fence was unrolled for stretching, they would break off, and portions of the original metal would be exposed. At the present time there are no facilities in the United States for galvanizing woven wire fencing so far as this committee has been able to discover, and the principal manufacturers say that they have no machinery for doing it.

Chairman Crumpton: I may say in connection with this subject that the changes, which are rather drastic, are really for the elimination of some of the articles and parts of the specifications, to harmonize the parts so that they come in as a consistent whole. With that in view I will move the adoption of the committee's conclusions.

(Motion carried.)

Chairman Crumpton: The report of the sub-committee on Signs will be found in Appendix B.

(F. D. Batchelor (B. & O.) submitted Appendix B.)

Chairman Crumpton: This question of signs has been up for quite a number of years, and the committee from time to time has recommended individual signs. This year they attempted to cover the whole field of signs, and feel that the signs that have been spoken of this morning, together with those that have been recommended by this committee before, and also those that were recommended by the signal committee and adopted, will practically cover the field of signs. You probably will notice some signs are missing, but it was felt that these were of minor importance, and each road should do as it pleased.

The committee moves the adoption of its recommendation.

G. A. Mountain (Can. Ry. Com.): I would like to ask the committee why they omit the private crossing signs? My experience is that they are very important.

Chairman Crumpton: One of the reasons that sign was omitted is that we found the practice on the different roads in the country, both in United States and Canada, varied so much that we thought it was practically impossible to get anything that would meet the conditions.

W. A. Christian (M. & St. L.): I notice the size of the corporation signs is quite large.

Chairman Crumpton: That was obviously an error in the size.

Hadley Baldwin (C. C. C. & St. L.): I notice that the committee recommends a sign for the beginning and end of the double track similar to the sign for the end of a block. The signal is different, and I wonder why they recommend the same kind of sign. They should be distinct, it seems to me.

Chairman Crumpton: Some time ago the question of signs was brought up and divided into two classes, one for the guidance of the engineman which had to do with the operation of the road, and the other for the information of the employees. Those in connection with the operation of the road were dealt with by the Signal committee, which adopted very distinctive designs. This committee was of the opinion that these signs should be given great prominence, but that the balance of the signs, the right-of-way signs, should be as inconspicuous as possible, and one form of small sign was adopted for information purposes, and this sign was used as much as possible without any variation, the idea being to save expense.

John V. Hanna (K. C. Term.): As to the use of the  $2\frac{1}{2}$ -in. wrought iron rod provided in some of these signs, I ask whether the committee has tried to work out a concrete rod for that purpose, and, if so, what difficulties they found.

Chairman Crumpton: As to the question of the 2½-in. pipes, every railroad has many old boiler tubes, and, as a great many roads use these, the committee carried out that idea.

J. B. Hunley (C. C. C. & St. L.): I note that the valuation section sign is cast iron, and the section post and the subdivision section post, which are practically the same, are steel plates. I was wondering why that difference was made. Of course, the section posts will be moved more frequently than the valuation section signs, and may be considered as of a less permanent nature, but, on the other hand, when they are moved they will be used again, and used until they are worn out. A cast iron sign would be more expensive.

Mr. Batchellor: I have nothing special on that, other than that the chairman took into consideration that the valuation sign was more permanent and not so frequently used as a section sign.

Mr. Hunley: That is true, but on the other hand the section signs, even if they are moved, will undoubtedly be used until they are worn out. The only purpose I can see about it is that with the cast letters it is absolutely permanent and fixed. I wondered what the idea of the committee was in recommending this.

Chairman Crumpton: The chairman of the sub-committee is not here, and that is a detail I do not know about. I know that the committee felt these valuation signs were very permanent, and when put up were put up once for all, and that applied also to the section signs.

Hadley Baldwin (C. C. C. & St. L.): Is it part of the recommendation of the committee that mile posts carry the numbers in both directions?

Chairman Crumpton: The committee discussed that matter and got information as to how mile posts should be numbered, and this is given merely as an illustration. It seemed to the committee that question should be settled, that is, roads should number from one terminal right through, and omit the double number, and as a matter of fact since the question of valuation has come into prominence this double numbering is leading to trouble.

The committee worked over that matter, but as I say, as so many roads have different practices, it was practically dropped, so far as this report is concerned, and we put in the mile posts, following the ordinary practice.

E. A. Frink (S. A. L.): I ask if the committee has developed any way of permanently marking the concrete posts and concrete signs?

Chairman Crumpton: The letters are indented.

*(Motion for the adoption of the recommendations carried.)*

Chairman Crumpton: The third assignment to the committee was "to make a final report, if practicable, on Grade Crossings, Crossing Gates, Crossing Signal Bells, and Warning Signals."

Maro Johnson (I. C.): These specifications are presented with the idea of bringing out the views of the members, and the committee would like suggestions on this subject.

The matter on warning signals is submitted as information.

C. E. Johnston (K. C. S.): It seems to me the part of the report relating to the interest of state authorities in co-operating with railroads in the matter of reducing the number of highway crossings, etc., is a very important one, and something on which the members of this association can accomplish a great deal if organized in some manner to investigate these new road projects and to ascertain in advance where grade crossings might be eliminated. In many cases the management of these

roads were advised of points where the roads might be changed, even with little cost to the railroads, it would mean saving to all the lines. As far as our lines are concerned, it has put an idea into my mind to canvass the entire territory to see where we can eliminate grade crossings.

G. A. Mountain (Can. Ry. Com.): Is it meant, in connection with the matter concerning warning signals and bells, that where a flagman is on duty bells should not be installed? Our experience is, where we have a fairly heavily traveled route, somewhat dangerous, more particularly traveled in the daytime, we have found it advantageous to put a watchman on and also install a bell. The bell is cut out during the daytime and it is cut in by the watchman for use at night, when the travel is not so heavy as in the daytime. It has worked all right in our case.

Mr. Johnson: I think that is the situation the committee has in mind. Mr. Mountain states the bell is cut out when the flagman is on duty, and that corresponds with our view of the matter, that the bell and the flagman should not be there at the same time.

Mr. Mountain: The wording says that the bell should not be installed.

Mr. Johnson: That conveys the wrong idea.

Mr. Mountain: In the report where it says: "On double track lines operation of warning devices is usually in the normal direction only," I would like to ask the committee if they will give consideration to that. Our view of it is that for wigwags and bells the bonding should be in both directions against the current of traffic, and there you are in a very dangerous position. You are operating a bell in the direction of traffic. When you are operating against the traffic there is no warning. It seems to me if anybody is injured under those circumstances, you are absolutely out of court.

Mr. Johnson: The committee found this was the practice on a number of railroads and followed that suggestion with the assumption that traffic in opposite directions is protected by a flag.

C. F. Loweth (C. M. & St. P.): I want to congratulate the committee on this report, especially that portion of it which deals with the present trend of legislation with relation to grade crossings, and especially that part of apportioning the cost between the municipalities and the railroads. I recently had occasion to read into the records at a committee of one of our state legislatures a portion of this report, showing especially the trend of recent legislation in respect to the apportionment of the cost of grade separation between the counties and towns and the railroads.

The chairman referred to the Wisconsin law, a recent law which the railroads are not very happy about, and that law provides that the State Commission may apportion to the railroad as much of the cost for the improvement of the highway as would represent the capitalization of the protection which the railroad has or should have at that crossing. Now, that works out very strangely sometimes and it has resulted in the railroad sometimes being assessed the entire cost of a highway improvement.

It seems this matter of the apportionment of cost between the parties interested, the state as well as the railroad, is one of very great importance and one that the railroads should be kept in very close touch with.

J. L. Campbell (E. P. & S. W.): In the matter of co-operation between the railroads and the community on the question of the costs of grade separation, as a rule the railway alone is not responsible by any means for the grade separation problem. It has been the rule in this

country that the communities have built up around the railways and the growth of the community itself, of which the railway is only a part, has created the problem.

I suggest that you can render a very important service for your companies and the properties with which you

are connected in connection with these grade separation issues by making the community understand its obligation and the mutual interest that it has.

(Committee was then excused with the thanks of the Association.)

## Report on Uniform General Contract Forms

Several revisions in the Manual are proposed, covering changes in the construction contract form and other agreements. A final report is presented for adoption on the form of lease agreement for industrial sites. The standardized form as submitted embodies the fundamental principles governing the preparation of this class of lease, and where not entirely adaptable because of peculiar or varying conditions, it can be modified or used as a guide. A form of license for wires, pipes, conduits and drains is also presented. Replies to a questionnaire on standardization of contract forms shows that a large amount of thought is being given to the question.



W. D. Faucette  
Chairman

W. D. Faucette is completing his first year as chairman and his fifth year as a member of the committee. As chief engineer of the Seaboard Air Line since December, 1912, he has had frequent opportunity to realize the value of standard forms for contracts, leases and similar documents. He has therefore been able to appreciate the importance of the work of this committee to an extent that men in less responsible positions would not and to direct the preparation of these standard forms with more enthusiasm. The report for this year testifies to the amount of attention which the committee has given to the work assigned to it.

IN ITS APPENDIX A, COVERING revision of the Manual, the committee recommended certain changes for adoption by the Association. In Appendix B is presented a tentative form of Wire Line Agreement, and in Appendix C there is presented for adoption by the Association a form of Lease Agreement for Industrial Site.

### Conclusions

(1) The committee recommends that the changes in the Manual be approved and that the revised matter be substituted for the present recommendations existing in the Manual or Supplements.

(2) The committee recommends that the form of license for wires, pipes, conduits and drains on railroad property set forth in Appendix B be received as information, and be assigned as part of the committee's work for the coming year.

(3) The committee recommends that the final report on Form of Lease Agreement for Industrial Site, Appendix C, be adopted and printed in the Manual.

In an Appendix D the committee presented a table of replies received to a questionnaire relating to the use of the standard forms adopted by the Association.

Committee: W. D. Faucette (S. A. L.), chairman; C. A. Wilson (Cons. Engr.), vice-chairman; C. F. Allen (M. I. T.), A. O. Cunningham (Wabash), G. L. Davenport (A. T. & S. F.), Clark Dillenbeck (P. & R.), C. E. Gifford (Br. Builders' Soc.), J. C. Irwin (B. & A.), E. H. Lee (C. & W. I.), O. K. Morgan (C. C. & O.), C. B. Niehaus (C. of Ga.), H. A. Palmer (G. T.), C. J. Parker (N. Y. C.), J. W. Pfau (N. Y. C.), A. C. Shields (C. R. I. & P.), E. L. Taylor (N. Y. N. H. & H.), Frank Taylor (C. P. R.).

### Appendix B—License for Wires, Pipes, Conduits and Drains on Railroad Property

(Tentative Form)

THIS AGREEMENT, made this.....day of..... 19.., by and between the..... hereinafter called the Company, and..... having a principal office or place of business in..... hereinafter called the Licensee,

### WITNESSETH, THAT:

Whereas, the Licensee desires to construct, maintain and use..... upon the property of the Company, situated in..... and more definitely shown on the plan hereto attached, designated as..... and dated..... and made a part hereof:

It is mutually agreed as follows:

1. The Company grants permission to the Licensee to construct, maintain, and use..... upon the property of the Company, in accordance with said plan and the specifications forming a part thereof, and subject to the requirements of the Company.

2. In consideration of this license, the Licensee shall pay to the Company, in advance, the sum of..... beginning.....

3. Every cost and expense of construction, maintenance, use and removal resulting from this license shall be paid by the Licensee. The Company may perform without notice any work which it considers necessary to the safe operation of the railroad. The Licensee shall do no work under this license, which may interfere with the operation of the railroad without the written permission of the Company.

4. Use of the property of the Company however long continued shall not affect any estate or easement in the Licensee or any rights other than license.

5. The Licensee shall indemnify, protect, and save harmless, the Company from and against all claims, suits, costs, charges, and damages, made upon or incurred by the Company in connection with this license.

6. This agreement may be terminated by either party by..... notice to the other party, or without notice on disuse by the Licensee for.....

7. Any notice given by the Company to the Licensee shall be deemed to be properly served if the notice be delivered to the Licensee, or if left with any responsible agent of the Licensee, or if deposited in the postoffice, post paid, addressed to the Licensee at..... last known place of business.

8. Upon termination hereof the Licensee shall forthwith remove all his constructions from the property of the Company, satisfactory to the Company. In case of the Licensee's failure so to do, the Company may at its option either retain such constructions or remove them at the cost of the Licensee.

9. This agreement shall not be assigned or in any manner transferred, without the written consent of the..... of the Company.

10. Until terminated as hereinbefore provided, this agreement shall inure to the benefit of and be binding upon the

legal representatives and successors of the parties respectively.

IN WITNESS WHEREOF, the parties hereto have executed this agreement on the day and year first above written.

Company.

Witness.....  
Witness..... By.....

### Appendix C—Form of Lease Agreement for Industrial Site

**Parties.** (1) THIS LEASE, Made in.....this.....day of.....19.., by and between the....., a corporation, the Lessor, hereinafter called the Company, and.....having a principal office or place of business in.....in the.....and....., hereinafter called the Lessee, WITNESSETH:

That the Company in consideration of the agreement of the Lessee herein contained, hereby leases unto the Lessee, all those certain premises, situated in.....County of.....State of....., described as follows:

**Description.** (2) .....the location and dimensions of said premises being more definitely shown on the plan hereto attached, designated as .....and dated.....and hereby made a part hereof.

**Term.** (3) To have and to hold same from.....19.., to.....19.., unless sooner terminated, as hereinafter provided.

**Termination.** (4) Either party hereto may terminate this lease at any time, by giving to the other party.....days' written notice to that effect. Acceptance of rent in advance by the Company shall not act as a waiver of the right to terminate this lease.

**Notice.** (5) Any notice given by the Company to the Lessee shall be deemed to be properly served if the same be delivered to the Lessee, or if left with any of.....agents, or if posted on said premises, or if deposited in the postoffice, postpaid, addressed to the Lessee at.....last known place of business.

**Rent.** (6) The Lessee shall pay a rental of.....per....., payable.....in advance, beginning on.....for the use of said premises, payable to the.....of the Company, at.....

**Refund.** (7) Rent paid in advance for a period extending beyond the termination of this lease shall be repaid to the Lessee within thirty days after demand, unless such termination shall be on account of violation or non-fulfillment of any of the terms of this lease by the Lessee, or on account of the abandonment of said premises by the Lessee, in which case the amount paid as rental shall be retained by the Company.

**Taxes.** (8) The Lessee shall pay all taxes, licenses and other charges which may be assessed or levied upon said premises, improvements thereon, and upon the business of the Lessee upon said premises, or against the Company by reason of occupation or use of said premises by the Lessee.

**Purpose.** (9) The said premises shall be used for the following purposes:.....

**Assignment.** (10) This lease shall not be assigned or in any manner transferred nor said premises or any part thereof sublet, used or occupied by any party other than the Lessee, nor for any other purpose other than that specified herein, without the written consent of the Company.

**Abandonment.** (11) The failure of the Lessee to occupy or use said premises for the purpose herein mentioned for .....days at any one time shall be deemed an abandonment thereof. An abandonment of said premises by the Lessee, shall operate as an absolute and immediate termination of this lease without notice.

**Improvement.** (12) The Company hereby gives to the Lessee, subject to all of the conditions hereof, the privilege of erecting, maintaining and using on said premises, suitable buildings and other structures for the aforesaid purposes; provided that such buildings and other structures shall be first approved by.....of the Company, and thereafter maintained as to meet with the approval of the.....of the Company; that the Lessee shall, so long as this lease continues, keep all buildings and other structures on said premises in good repair, including painting, so as to present a good appearance, so far as required by such.....and that the Lessee shall install, rearrange and maintain such improvements as may reason-

ably be required by said Company for the reduction of fire hazard.

**Clearance.** (13) The Lessee shall neither erect nor place, nor permit to be erected or placed, upon said premises any structures or obstruction that will in any way imperil the safety of trains, engines or cars upon such railroad tracks as are now or may hereafter be located on, or adjacent to said premises, or the safety of persons or property in, upon, or about such trains, engines or tracks. The minimum horizontal and vertical clearances from the tracks shall be prescribed by.....of the Company upon request.

**Removal of Improvements.** (14) Upon the termination of this lease in any manner, the Lessee, upon demand of the Company, without further notice, shall deliver up to the Company the possession of said premises, and shall if required, remove all the improvements placed thereon by the Lessee, and restore said premises to substantially their former state, and in case the Lessee shall fail, within.....days after the date of termination of this lease, to make such removal or restoration, then the Company may, at its election, either remove said improvements and restore said premises for the account and at the sole cost of the Lessee, or may take and hold the said improvements as its sole property.

**Inflammables.** (15) No goods of an explosive, dangerous or inflammable nature or character shall, in any case, be stored in or upon said premises without the written consent of the Company.

**Condition of Premises.** (16) The Lessee shall at all times keep said premises and the vicinity thereof, in a safe, clean and sanitary condition. The Lessee shall not mutilate, damage, misuse, alter or commit to suffer waste in premises.

**Advertising.** (17) No advertising shall be placed upon said premises or upon any structures thereon, except for the Lessee's own legitimate purposes, and all advertising so placed shall be to the satisfaction of the.....of the Company.

**Laws and Regulations.** (18) The Lessee shall in all respects abide by and comply with all laws, rules, regulations and ordinances affecting the said premises.

**Miscellaneous Charges.** (19) The Lessee shall pay all charges for water and lighting and for street or road sprinkling, sweeping and oiling, that may be levied or assessed against said premises, covering the period of occupancy.

**Snow and Ice.** (20) The Lessee shall at all times keep the sidewalks in front of said premises free and clear of snow and ice, and any expense to the Company by reason of the failure of the Lessee so to do shall be paid by the Lessee to the Company upon demand therefor; such expense to include all loss or damage of whatsoever character, either to persons or property.

**Use of Tracks.** (21) The Lessee shall not permit nor allow tracks belonging to others than the Company to be constructed upon said premises, and the Lessee will not permit nor allow trains or engines belonging to others than the Company to be used upon or given access to said premises, without the written consent of the Company.

**Company's Right of Entry.** (22) The Company shall have the right at all times to enter upon and to construct railroad tracks on said leased premises, and to maintain and operate, and to extend or change the location at any time, of such tracks as are then on said premises, upon.....days' written notice to the Lessee. If any structure on said premises shall obstruct or interfere with the construction of additional main or passing tracks of the Company, or if required for proper clearance of tracks, the Lessee at.....expense, shall promptly move such structure to another location, either on or beyond said premises as may be necessary, upon.....days' written notice to the Lessee.

**Access to Premises.** (23) In the event it is necessary for the Lessee or his agents, servants, workmen and customers to pass over other lands of the Company and railway tracks of the Company, to have access to and from said premises, all such persons shall make use only of the way indicated by the.....of the Company for that purpose, and the Lessee hereby expressly assumes all the risk of accident and injury to the person and property of all such agents, servants and workmen, and all others resorting to the leased premises in connection with the Lessee's business, whether the same be occasioned by the negligence of the Company's servants or in any other manner whatever, and the Lessee shall indemnify the Company from and against all claims, suits, costs and charges made upon or incurred by the Company by reason or in consequence of any such accident, loss and injury.

**Liability.** (24) (a) The Lessee assumes all responsibility for and agrees to indemnify the Company against loss or damage to property of the Lessee or of others upon said

premises, regardless of negligence of the Company, arising from fire caused by locomotives operated by the Company in serving the lessee upon said premises, or in the vicinity thereof, except to rolling stock belonging to the Company or to others, and to shipments in the course of transportation.

(b) The Lessee agrees to indemnify, protect and save harmless the Company for loss of, damage to, or destruction of property of the Lessee or of others upon said premises whether caused by fire or otherwise (except fire caused by locomotives as hereinbefore provided for), or for death of or injury to, any person or persons, arising out of the construction, maintenance, use, or operation on said premises (except where such death or injury was due solely to negligence of the Company).

**Forfeiture.** (25) Any breach of any covenant, stipulation or condition herein contained to be kept and performed by the Lessee, shall after.....days' written notice, if continued, at once terminate this lease, and all rights of the Lessee hereunder. No further notice of such termination or declaration of forfeiture shall be required, and the Company may at once re-enter upon said premises and repossess itself thereof, and remove all persons therefrom, or may resort to an action of forcible entry and detainer, or any other action to recover the same.

**Right of Inspection.** (26) The said premises shall be open at all reasonable times to the inspection of the Company, its agents, and applicants for purchase or lease.

**Renewal.** (27) If the Lessee, with the consent of the Company, holds over and remains in possession of said premises after the expiration of said term, this lease shall be considered as extended, and shall continue in effect from.....to....., subject, however, to termination as herein provided, and upon the same terms and conditions as are herein contained. Until terminated as hereinbefore provided, this lease shall inure to the benefit of and be binding upon the parties hereto, their heirs, executors, administrators, successors and assigns.

IN WITNESS WHEREOF, the parties hereto have executed this lease on the day and year first above written.

.....  
Company.

Witness:.....

Witness:.....

By.....

### Discussion

(J. L. Campbell (Second Vice-President) in the Chair.)

G. H. Wilson (Vice-Chairman): Three subjects were assigned to the committee for attention this year. The first is "Make thorough examination of the subject matter in the Manual and submit definite recommendations for changes. This subject was handled by a sub-committee, of which Mr. Clark Dillenbeck is chairman.

Clark Dillenbeck (P. & R.): The committee has carefully gone over the Manual and made recommendations for certain changes as here shown. The first is "Construction Contract Forms." And we propose that this heading be changed to "Form of Construction Contract." In going over the Manual we noticed that the headings varied considerably and it was the thought of the committee that it would be well to make them uniform.

With reference to form of proposal, page 655, it is recommended that this be placed to precede "(A) Agreement." It appeared to the committee that this one page in the form is out of place and should be placed preceding the "(A) Agreement."

The next suggestion is Section 30, change the heading in the first paragraph. It is proposed to change the heading to read "Land of company, use of by Contractor." And there is a new proposed form under this heading. (Read proposed form.)

Section 32, page 662, has reference to the annulment of contract and the present reading of it is that the contractor shall be paid for the work annulled. We simply change the reading of the last line and say that "payments shall be made for work done on such portion so abandoned, as provided in Section 38 of this contract."

Section 34, page 663, it is simply suggested to omit the words "30 days" from the second and third lines. Under the present reading after a contract has been annulled,

the contractor would be permitted to continue the work for 30 days, and it is the thought of the committee that it is frequently the case when contracts are annulled that work must be stopped at once.

On page 666, change the heading "Bond" to "Form of Bond."

In the form, "Industrial track agreement," change the heading to read "Form of Industry Track Agreement."

The committee realizes the changes are necessary in the form and regrets that definite recommendations must be abandoned to a later date. The principal reason for this is that the matter was under consideration by the corporate engineers. I believe they had reported to the executives and their report has not been approved, and also the freight traffic department is expecting an order from the I. C. C. With these things staring us in the face we did not see that we could properly go ahead and correct this agreement.

In the agreement for interlocking plant, change the heading to read: "Form of Agreement for Interlocking Plant," and omit the whole Section 9, on wage rates.

Owing to the present rules of the Labor Board we thought that was not compatible with present practice.

In the form headed, Agreement for grade crossings, change the heading to read: "Forms of Agreement for Crossing of Railroad at Grade." The present heading simply reads: "Agreement for Grade Crossings," and grade crossings are generally spoken of as highway crossings and it was the thought of the committee we had better change it as noted. We also suggest omitting the first note which refers to Federal control, and change the words "Grade crossing" to "Railroad crossing at grade," wherever they occur.

The committee recommends that the above changes in the Manual be approved and that when the Manual is reprinted the changes be incorporated therein.

(Motion to accept the changes was carried.)

Vice-Chairman Wilson: The second subject is to be a report on forms of agreement embodying rules governing the construction of undercrossing of railways with electrical conductors, conduits, pipe lines, and drains, conferring with Committee on Roadway and Electricity."

This will be presented by Mr. J. C. Irwin.

J. C. Irwin (B. & A.): The sub-committee on the preparation of this form collected a large number of agreements used by American railroads and, of course, found a great diversity of practice in the majority of these cases. The specification formed part of the License for Wires, Pipes, Conduits and Drains on Railroad Property, but in some there are other forms of license which seem to apply better to this particular case, and the committee proceeded on that basis.

This suggested agreement is presented in tentative form. This is the first time it has been brought before the convention, and we believe it is approximately correct. It is submitted for discussion, merely as information, with the request that it be laid over until next year for final action.

(Mr. Irwin here abstracted Appendix B.)

Vice-Chairman Campbell: If there are no objections, this subject will be left with the committee for further study and report. The committee invites written criticism by the membership during the year on this proposed form.

(Vice-Chairman Wilson read Lease Agreement for Industrial Site, and "Conclusions" (3).)

Vice-Chairman Wilson: I move that this recommendation be adopted.

(Motion carried.)

(The committee was excused with the thanks of the Association.)

## Report of Committee on Water Service

Considerations of sanitation make it highly desirable that the supply of drinking water on railroads be under the direction of an officer with competent training in sanitary engineering. The incrustation of pipe lines results in great losses through reduced discharge and higher costs of pumping which can be overcome by mechanical processes for cleaning the pipes. The "after precipitation" in injector pipes can be overcome with the use of ferrous sulphate. Waste water at water stations results in loss of the water and increased cost of track work. Specifications for the substructures for steel and wooden water tanks are submitted in the report.



A. F. Dorley  
Chairman

A. F. Dorley has served as chairman of this committee for the past eight years, which is a well-earned record for continuous service as chairman. He was a member of the committee two years previous to his appointment as its leader. Mr. Dorley is now district engineer on the Missouri Pacific, with which road he was engaged for a number of years as engineer of water service. While occupied in this capacity the road made marked advances in water treatment and it is because of his connection with this and other developments in railway water service that his experience has been of particular value to the water service committee.

**A** PROGRESS REPORT on the Supply of Drinking Water on Trains and Premises of Railroads appears in Appendix A. Plans and Specifications for Typical Water Station Layouts are submitted in Appendix B.

The Extent and Effect of Incrustation in Pipe Lines is reported in Appendix C and is followed by a monograph by C. H. Koyl.

A final report on the Disposal of Water Waste appears in Appendix D.

The Effect of Local Deposits on Pollution of Surface or Shallow Well Water Supplies is reported in Appendix E.

Specifications for Substructures of Wood and Steel for Water Tanks is covered in a final report in Appendix F for adoption and publication in the Manual.

### Conclusions

The committee requested the following action on its report:

- (1) That the subject of examination of the subject-matter in the Manual be again referred to the committee for further study and report.
- (2) That the report on progress of drinking water regulations be received as information and that the subject be reassigned to the committee for further study and report.
- (3) That the report on typical water station layouts be received as information.
- (4) That the report on extent and effect of incrustation in pipe lines and methods for cleaning be received as information.
- (5) That the report on methods of disposing waste water at water stations be received as information.
- (6) That the subject of specifications for contracting water service be reassigned to the committee for further study and report.
- (7) That the progress report on effect of local deposits on the pollution of surface and shallow well water supplies be received as information and the subject be reassigned to the committee for further study and report.
- (8) That report on specifications for substructures of wood and steel for water tanks be adopted and published in the Manual.

Committee: A. F. Dorley (M. P.), chairman; C. R. Knowles (I. C.), vice-chairman; R. C. Bardwell (M. P.), I. H. Davidson (M. K. & T.), G. B. Farlow (B. & O.), J. H. Gibboney (N. & W.), E. M. Grime (N. P.), W. C. Harvey (C. G. W.), R. L. Holmes (T. & P.), H. H. Johtz (M. K. & T.), C. H.

Koyl (C. M. & St. P.), P. M. LaBach (C. R. I. & P.), E. G. Lane (B. & O.), Thomas Lees (C. P. R.), M. E. McDonnell, W. M. Neptune (M. P.), W. A. Parker (U. P.), E. H. Olson (A. T. & S. F.), A. B. Pierce (Sou.), C. P. Richardson (C. R. I. & P.), F. D. Yeaton (C. M. & St. P.).

### Appendix A—Study Regulations of Federal or State Authorities Relating to Supply of Drinking Water on Trains or Premises of Railroads

At a meeting held by the sub-committee in the office of the Association on June 3 a representative from the office of the Surgeon-General was present and placed before the committee the following points outlining the position taken by the Public Health Service:

"First, it must be pointed out that the responsibility for furnishing or producing water safe for drinking purposes is a large and serious one, fully comparable with any of the other obligations or responsibilities of the common carriers. The railroads, therefore, must comply fully with accepted modern standards for the production and handling of water for drinking purposes.

"Second, the former and even the present methods of selecting and handling drinking water supplies by the railroads are in need of extensive improvements, which it is now imperative that the fullest consideration be given by the railways.

"Third, it is considered with adequate justification that satisfactory conditions in regard to railway water supplies can only be obtained by the responsible supervision over sanitary factors of the water supplies by a competent and qualified sanitary personnel of the railway organization, varying to be sure with the size of the system. In this connection, it has been noted with some concern that the recently adopted scheme of Water Service Organization contains no provision for the specific responsibility and supervision of the sanitary quality and safety of the drinking water supplies on railroads."

It was brought out in the discussion that the question of a pure drinking water was as much a question of safety as the standard mechanical safety appliances and should be so regarded. The chief objections raised appeared to be in the methods of handling of the water in and to containers on cars. A safe sanitary supply may be readily polluted by improper handling. One of the chief faults has been in lack of protection for the hose connection from hydrant to car reservoir.

It is the recommendation of the committee that the

detailed supervision of drinking water supplies on railroads should be under the authority of an officer with competent training in sanitary engineering, and such personnel should work in close co-operation with the recommended Water Service Organization as presented at the last convention.

### Appendix C—Extent and Effect of Incrustation in Pipe Lines

In pursuing the study of the subject a questionnaire was sent to different railroads, covering practically all the United States, covering the following headings: Incrustation, nature, extent, cause.

Method of cleaning.

Results obtained from cleaning.

Replies were received which show that stoppage of pipe lines by foreign materials is to be found in all territories. Some replies indicate that certain railroads do not know of its existence, but municipalities in the same area report trouble and measures for its removal. One road reports a 4-in. line in Maryland as practically showing no diminution in diameter after forty years' service. This was ascertained on removal.

#### GENERAL CAUSES AND CHARACTERISTICS

A large proportion of stoppages is due to corrosion, tubercles or roughening of interior surface. Where pipe is well coated, before laying, trouble of this nature is not generally to be expected in ordinary water for a number of years. While in itself it may not result in serious trouble, it usually forms the foundation for other deposits by roughening the interior of the pipe. The amount of deposit depends entirely on local conditions.

Mud or suspended matter (other than found as a result of water treatment) seldom forms a deposit unless the foundation has been already laid. The amount found depends largely upon the nature of the water and the velocity of the flow.

Snails and similar growths are frequently found in suction lines, but little information is to be found on the subject.

Iron, manganese or aluminum promote the growth of various forms of *Crenothrix* in pipes or reservoirs. When these substances are absent apparently no difficulty is found from this source.

The usual sequence is for the pipe to roughen through corrosion. The mud or slime is deposited which forms a culture bed for a variety of growths.

Incrustation due to water treatment is commonly found in treating plants of various types. This deposit is greatest when the water is undertreated or raw and treated water are mixed in the pipe lines. There is also difficulty due to water being used before the reactions are complete. There is no evidence that filters will entirely eliminate this trouble, as the reaction frequently takes place after the chemicals pass the filter. That a good filter will help there is no question.

The application of heat will deposit a scale largely composed of the carbonates of lime and magnesia. In treated water the changes in temperature will also cause a deposit. When the temperature rises in passing from the treating tank any excess of lime or magnesia will deposit. The reverse is true of soda. As any excess is generally carbonate of lime, the latter is usually the main source of deposit.

#### METHOD OF CLEANING

The cleaning of pipe by hand can only be done when the deposit is comparatively soft. It is sometimes possible in short pipes under special circumstances to clean them in place by using a scraper of some sort, but mechanical means are usually found more effective.

Mechanical means are most frequently used. The pipe line may be removed and a revolving cutting tool fixed on a shaft pushed through the section of pipe. This has been found to answer the purpose with an air motor and a special cutting tool on a 13-ft. shaft. Flue cleaners have also been used for the same purpose.

The latest method is to clean the pipe in place. This is done by opening the pipe line in two places and running a cable between them. This cable is used to drag a cutting tool behind it. One railroad has used a flue cleaner successfully. However, most of the work has been done by contract.

What may be accomplished by cleaning, irrespective of the method, is given in the following cases:

An 8-inch main, 11,575 ft. long, was cleaned September, 1909. Pressure required before cleaning 140 lb. for 400 gal. per min. After cleaning 49 lb. was required to deliver 450 gal.

A 6-inch main 7,200 ft. long. Former pressure at pumps 85 lb. New pressure 65 lb. Former capacity 180 gal. per min.; new capacity 220 gal. per min.

Valves, etc., around treating plants or where treated water is used are usually cleaned by the use of hydrochloric acid. The pipe lines can be cleaned by the same process, but the cost would generally be prohibitive unless the chemicals are recovered. This method is used at times, but the committee has not sufficient information as to its practicability.

#### PREVENTION

Flushing is generally nothing more than a mechanical method. It may be used if the local conditions are proper. It will prevent the formation of chemical deposits but rarely. Raw water used to flush lines which may carry uncombined chemicals will only aggravate the trouble.

Aeration before pumping will aid where the water contains iron. Adding to the aeration in intermittent treating plants is a preventive when the treatment is too short for completed reactions. The same may be said of any type of agitation.

The prevention of chemical reactions in the pipe lines will, as a rule, stop all incrustation. By the nature of the subject this is not possible. It may be said that the better and more complete the treatment the less the trouble will be. No method has been devised which will eliminate temperature changes and their resultant effect.

The specifications for cleaning by contract usually include a stipulation that the pipe line will be restored to within 5 per cent of the normal friction loss as taken from a standard set of tables. This seems to have been attained when the contractor agreed to operate without injury to the coating in the inside of the pipe.

#### CONCLUSIONS

Pipe cleaning will pay when the water horse power hour cost per year is reduced sufficiently to pay 7 per cent interest on the amount needed for the improvement.

Pipe line cleaning will pay if there is a shortage when the cost of cleaning is less than the cost of an additional pipe line needed for adequate service.

#### After-Precipitation from Treated Water—Its Cause and Prevention

By C. H. KOYL, Engineer Water Service, Chicago, Milwaukee & St. Paul

In the early days of water softening in this country—from 1898—it was noticed that after water had been through the softening process, completed by passing through some simple kind of filter like a packed 12-in. of wood excelsior or a thin bed of sand from which it

issued brilliantly clear, there was a deposition of flakes of carbonate of lime found on standing.

After studying this for some time it became evident that the chemical reactions had not been completed in the softening plant—that the last molecules of calcium-oxide ( $\text{CaO}$ ) had not found the last molecules of carbon dioxide ( $\text{CO}_2$ ); and since chemical reaction is almost instantaneous when once the atoms or molecules are within combining distance it was evident that the lime had not been thoroughly mixed with the water.

I then made a series of tests to determine the amount of mechanical mixing necessary to effect a softening down to three grains per gallon, at which point the reactions in ordinary water are nearly complete, and found it to vary from 25 min. in clean well water at 60 deg. F. to 50 min. in river water at 45 deg. F. Thereafter I built a reaction (mixing) tank as part of every "continuous" water softening plant.

In those days the "intermittent" plants, whose tanks were filled with water, treated with the proper amounts of lime and soda, well stirred for 20 min. and then settled for three hours, were doing excellent work. But "continuous" plants had solutions of lime and soda in proper portion continuously added to the incoming stream of water and the combination run around a few baffle boards for mixing purposes, and the softened water from these plants all deposited flakes of calcium carbonate on standing; and if the water was passed through a sand filter or through a pipe while the deposition was taking place small particles attached themselves to the sand grains or the pipe walls, and the sand grains were said to "grow" and the pipe to be incrustated.

The addition of a 50-min. mixing chamber as a preliminary to the settling chamber of the "continuous" water softening plant did away with this "after precipitation" and I never saw enough of it from one of these plants to be noticeable. It was remarked, however, that if the water was undertreated in lime after disposition took place in spite of the 50-minute mixing, for undertreated water requires much longer mixing than that. It was still noted, too, that when the best of treated water was fed to locomotive boilers through injectors there was a sufficient deposition in the injector and branch pipe and on the check valve to interfere with the operation of the injector.

In the winter of 1915-16 there was a treating plant at every water station on the Great Northern on the line from Devils Lake, N. D., to Shelby, Mont., a distance of nearly 700 miles, all near the Canadian border; and while boiler leaking was unknown there was so much trouble from clogging of the injectors that its prevention became a serious study.

The material deposited in the injectors was calcium carbonate. It came from the water at a temperature not far above 212 deg. At this temperature the content of calcium carbonate can be reduced to about two grains per gallon, but calcium sulphate, if it were present, would not be affected. Therefore, I decided to try to convert at least part of the 3 grains of calcium carbonate in the cold water into calcium sulphate by adding three grains per gallon of ferrous sulphate to the water before it left the mixing tank of the treating plant. This would leave in the water a small amount of ferrous carbonate which would give the injector no trouble.

The first test was made at Minot, N. D., because the switch engines in the yard had been the subject of continuous complaint. The water was treated as above for one month and then a switch engine was taken to the round house and its injector, branch pipe and check valve were found as clean as the day they were made. Imme-

diately thereafter the treatment with ferrous sulphate began to be extended to all treating plants on the line and the results have been uniformly good. On this road, so far as water is concerned, the winter handling of locomotives is as simple as the summer's.

#### Appendix D—Methods of Disposing of Waste Water at Water Stations and Keeping Track Free of Ice

It is impracticable to have a very wide range of movement for water tank spouts and so it is imperative that locomotives be carefully spotted at points where water is received direct from a tank spout. Also on divisions where both high and low locomotive tenders are in use, it is desirable to have the manholes on the low tenders raised up to the same height as that of the high tenders.

Where a rigid spout is used a sleeve, hanging by chains from the end of the spout, serves in a measure to make it adjustable for high and low tenders, but it does not entirely eliminate waste. The telescopic type of water column has now been made standard on some railroads and where it is in use there is very little water waste.

At water tanks there is frequently more or less waste due to firemen raising the spout before the water has entirely cleared from it or due to slight leakage from the tank valve. The maintenance of tank valves is a matter which must receive close attention from the water service department, especially in the winter season.

One of the best plans for taking care of the situation at a water tank is to ballast the track in the immediate vicinity for a distance of 10 ft. each way from the spout with a heavy layer of crushed rock and provide a catch basin with a grating cover directly under the end of the outlet pipe with an inlet at the level of the subgrade.

For the northern latitudes, such catch basins should have a sewer connection at least eight feet below the surface so the water will be rapidly carried off before it has an opportunity to freeze. A catch basin of this type is giving excellent service in North Dakota.

Where a steam pumping plant is located not too far away from the tank, a steam pipe connection into the catch basin will be a big help in keeping the drainage channel clear and the expense will be nominal. Catch basins may also be used to advantage near water columns. Where there is no danger from frost, some saving may be made by building the catch basin as a part of the water column pit. In cold climates the catch basin drain should not connect direct with the standpipe pit, as cold air entering through the drain is liable to cause freezing at the standpipe.

#### Appendix E—Effect of Local Deposits on Pollution of Surface or Shallow Well Water Supplies

1. (a) Water obtained from rivers, lakes, wells and other sources of supply usually contain a considerable quantity of foreign matter in suspension and solution, not only as inert mineral substances, but also in the form of living organisms and waste products or organic origin.

(b) Recent observations and experiments have proven that water in its raw state from small streams, lakes and reservoirs may be rendered unfit for locomotives or industrial use by reason of surface pollution, the effect of sewage, mine, drainage, coal storage, industrial waste and decayed vegetation on locomotive and industrial water supplies is very detrimental.

##### EFFECT UPON SURFACE SUPPLY

2. (a) *Coal Mines and Storage*.—Cases are known where coal mine drainage modifies or completely changes the character of streams. The most objectionable property of water containing mine drainage is its corrosive-

ness. The iron sulphates and acid will actively attack metals. Ferric sulphate (a common constituent of mine drainage) once admitted into a boiler will induce serious pitting conditions. The ferric sulphate will dissolve sufficient iron to reduce itself into the ferrous condition, and being oxidized by the air admitted with fresh water will again attack the boiler, and by continuous repetitions of this process will accomplish its early ruin. Brass piping or acid proof bronze is not immune.

The storing of coal on reservoir sheds should never be permitted. Reservoir water has been made unusable by this practice.

(b) *Cinders*.—It is a fact that water station attendants waste their cinders in places most convenient to them and usually they are deposited adjacent to the water supply. Cinder deposits should not be permitted near a surface water supply nor upon the water shed of surface reservoirs. Sulphates in large quantities are found in cinder deposits and are a source of contamination.

(c) *Oil Wells*.—Waste water from oil wells have been found to be highly mineralized and has been known to render surface reservoir water unfit for both boiler and domestic uses. This source of pollution should be guarded against by carrying the injurious waters to another shed or beyond the catchment area of the reservoir.

(d) *Sewage and Industrial Waste*.—Surface reservoirs should not be located where they will be subject to the flow of sewage or industrial waste, especially those of relatively small capacities. Water in small reservoirs has been known to have increased three hundred per cent in total solids, consisting of sulphates, chlorides and organic matter, by reason of sewage and industrial waste.

(e) *Mud and Cultivation*.—The committee thus far is unable to determine the effect of mud upon a surface supply, except that it materially reduces the capacity of the reservoir, primarily caused by permitting cultivation too near the flood line.

Water from an extensively cultivated catchment area is more or less turbid and for this reason is at times objectionable.

Turbidity and suspended mineral matter may be greatly reduced by using rapid sand filters, allowing about 3 GPM per square foot filter area.

#### EFFECT ON SHALLOW WELLS

3. (a) *Storage Coal*.—Storing coal near or in a position where the drainage therefrom will flow near a shallow well supply should not be permitted.

(b) *Cinder Deposits*.—Cinder deposits adjacent to or near a shallow well supply will in time give serious trouble. The ground under and adjacent to cinder piles will become saturated with objectionable chemicals, which through seepage will render the water in its raw state unfit for locomotive or industrial use.

#### Appendix F—Specifications for Substructures of Wood and Steel for Water Tanks

*Number of Posts*.—There has been but little change in the type of construction of substructure or towers for wooden tanks having a capacity of 50,000 gal. or more, the common practice on American railroads being a 12-post structure of 12 by 12 timbers, braced according to height.

Steel frames for wooden tanks, and in a great many instances for flat-bottom steel tanks, have also been of the 12-post type. This Association found in 1910 that 82 per cent of the 50,000-gal. tanks were supported on 12-post towers, 10 per cent on 16 to 26-post towers and 8 per cent on 4-post towers. Of the 100,000-gal. tanks 100 per cent had 12-post towers, with one exception of a 4-post tower. The general practice of constructing

12-post towers is explained in the fact that it is possible to secure a better distribution of the load with a 12-post structure and to support every part of the tank bottom without an elaborate floor system. It also permits of a good distribution of the foundation load and represents the most economical type of construction.

*Height of Substructure*.—The Water Service Committee reports on this in specifications for wood and steel water tanks, Volume 11, Part 2, page 1148.

*Bracing*.—While the general practice followed in construction of posts and floor system appears to be fairly uniform, the practice as to bracing is divided between plank bracing and strut bracing. The superiority of the strut type of bracing is recognized, but many roads have adopted the plank bracing on account of the lower cost.

The earlier type of construction of steel or iron towers consisted largely of bolted or riveted round columns and in some cases box columns. This was followed by the so-called star post or a post built up from angles. The objection to a post of this type is that it provides spaces in which moisture may collect and causes deterioration through corrosion which cannot be prevented. The best and most economical type of construction appears to be with post constructed of 6 in. by 6 in. by  $\frac{1}{2}$  in. angles for the 50,000-gal. tank and 8 in. by 8 in. by  $\frac{1}{2}$  in. angles for the 100,000-gal. tank. Three in. by 3 in. by  $\frac{1}{4}$  in. bracing would be sufficient with a post of this kind, but on account of providing for possible corrosion it is considered advisable to use a 3 in. by 3 in. by  $\frac{3}{8}$  in. angle for bracing. The floor system consists of 10-in. 25-lb. I-beams for tying in the different bents, joists constructed of 7-in. 15-lb. I-beams and caps of 12-in. 31 $\frac{1}{2}$ -lb. I-beams.

It is customary to include foundation bolts for steel towers, although they are seldom used on wooden towers. It would appear that there is little necessity for use of anchor bolts on tank towers 20 ft. or less in height.

It is the practice on some railroads to use steel floor joists instead of timber on wooden substructures, while a number of other roads advocate the use of second-hand steel rails for joists. The advantage claimed for the steel joists is that they will have a life equal to that of the tub, while untreated timber joists would have to be renewed at least once during the life of the tub. While this is perhaps true the same thing is true of all other parts of an untreated wooden substructure.

#### SPECIFICATIONS FOR STEEL SUBSTRUCTURES FOR WATER TANK OF 50,000 AND 100,000 GAL. CAPACITY

**General**.—1. The structure will consist of a 12-post steel tower, complete in all details, as shown on the attached plan, for supporting a wooden water tank of the specified size and capacity at the required elevation. The intent of the plans and specifications is to include all material required between the top of foundation and the bottom of tank.

**Material**.—2. Except as may be herein noted all metal in the structure will be made in accordance with specifications of the Association as given in Part Second, "Iron and Steel Structures," Manual of Recommended Practice (pages 494 to 499, 1915 edition).

**Workmanship**.—3. Except as may be herein noted workmanship on the structure will be performed in accordance with the requirements of the Association as given in Part Second, "Iron and Steel Structures," Manual of Recommended Practice (pages 499 to 503, 1915 edition).

**Painting**.—4. Steel work before leaving the shop shall be thoroughly cleaned and given one good coat of red lead ground in linseed oil or such paint as may be specified by the engineer. Except as herein noted, cleaning and painting shall be done in accordance with specifications of the Association as given in Part Second, "Iron and Steel Substructures," Manual of Recommended Practice (pages 503 and 504, 1915 edition).

#### SPECIFICATIONS FOR TIMBER SUBSTRUCTURES FOR WATER TANKS OF 50,000 AND 100,000 GAL. CAPACITY.

**General**.—1. The structure will consist of a 12-post timber tank tower complete in all details, as shown on the attached

plan, for supporting a wooden water tank of the specified size and capacity at the required elevation. The intent of the plans and specifications is to include all material required between the top of foundation and the bottom of tank.

**Timber.**—2. The timber shall be cypress, pine, fir, redwood, or such other timber as may be specified by the engineer, S. 4 S. and conforming to the specifications of this Association for No. 1 railroad bridge timber, as given in "Wooden Bridges and Trestles," Manual of Recommended Practice (pages 231 to 235, 1915 edition).

**Workmanship.**—3. All workmanship shall be in accordance with "Specifications for Workmanship for Pile and Frame Trestles to Be Built Under Contract," Manual of Recommended Practice (pages 238 to 241, 1915 edition).

**Metal Details.**—4. All metal details shall conform to the specifications of the Association as given in "Specifications for Metal Details Used in Wooden Bridges and Trestles," Manual of Recommended Practice (pages 236 to 238, 1915 edition).

**Painting.**—5. All exposed woodwork shall be painted with one priming and two finishing coats of such paints and colors as may be specified by the engineer.

**Treating.**—6. Where treated timber is used timber shall be treated with creosote oil in accordance with the requirements of Committee on Wood Preservation, Manual of Recommended Practice (pages 539 to 559, 1915 edition).

### Discussion

A. F. Dorley (Chairman): The subject assigned to the committee for study and report are eight in number. The first subject is the revision of the Manual. Last year the committee recommended an entire rearrangement of the subject matter in the section of the Manual given over to water service. They also recommended certain changes in the recommended practice pertaining to water supply and water purification, and the committee has no additional changes to submit this year.

The supply of drinking water on trains and premises of railroads is a subject that has been in the hands of a special committee, of which R. C. Bardwell is chairman. The committee has kept in touch with the development of the regulations of the federal and state authorities, and the report of the sub-committee will be found in Appendix A. The work of this sub-committee is being closely followed by the health authorities at Washington, a representative of the office of the Surgeon General having attended one meeting of this sub-committee last June. The report on this subject is offered for information.

It is not an uncommon sight in railroad terminals today to see employees dragging the hose through which water is passed from the hydrant into car-containers along the ground and into the accumulation of filth that is generally around tracks or terminals, and it is not very hard to imagine that the chances of polluting an otherwise pure drinking water are very great by allowing a practice of this kind. One large mid-western railroad has made an effort to prevent pollution of this kind by using a protection for the hose which has only recently been devised and put into service and it is offered with the suggestion that other railroads try some such scheme.

The third subject is the making of a final report, if practicable, on plans and specifications for typical water station layouts. The committee feels that this subject should more properly come within the scope of the committee that has in hand the design of yard terminals, and that the work of the Water Service Committee be confined to devising facilities to supply water to locomotives, or to make it available.

The fourth subject is the extent and effect of incrustation in pipe lines and methods of cleaning.

The sub-committee that had this subject in hand, of which P. M. La Bach was chairman, offers the report given in Appendix C. This report is almost entirely the work of Mr. La Bach, and he reviews the subject, beginning with the causes leading up to incrustation, the operating costs affected, the methods for cleaning, pre-

vention suggestions that were offered for prevention, as well as the condition under which the cleaning of pipes is economical. Before I go to subject No. 5 I wish to call attention to a monograph by C. H. Koyl, on the subject of after-precipitation from treated water, its cause and prevention. This monograph is made part of the report on the incrustation of pipe lines.

The fifth subject is in the disposition of waste water at water stations, and on keeping tracks free from ice is covered by the report appearing in Appendix D. We believe the lesson to be drawn from this study is that railroads should as far as possible eliminate the waste water. There are several railroads, particularly the Illinois Central, that have had under way for several years a campaign to eliminate water waste, and the results in the saving of money have been astonishing. Water is only too frequently looked upon as free as air, and it may be as free as air while it is going by in the river, but it takes money to put the water into a tank or to put it under pressure in a pipe line. Railroad officials who sign vouchers in payment of water purchased from city or water companies, realize that waste of water means real money flowing into sewers or into drainage ditches.

The committee reports progress on the sixth subject, covering specifications for contracting water service work.

The seventh subject deals with the effect of local deposits on pollution of surface or shallow well-water supplies. The report on this subject will be found in Appendix E, the work of the sub-committee, of which R. L. Holmes is chairman. I would like to call particular attention to the section which makes reference to the pollution of well water and surface supplies from the storage of coal and cinder deposits. This source of pollution only recently attracted the attention of this committee. We will have more to say on this subject in the final report which we hope to make next year. In the meantime we would like to caution railroads against the very serious possibility of polluting reservoirs or wells by storing coal adjacent to the water supply.

This brings us up to the last subject, No. 8, covering specifications for sub-structures of wood and steel for water tanks. The final report on this subject will be found in Appendix F. The preparation of these specifications and the typical plans in the work of the sub-committee of which C. R. Knowles is chairman. There is so wide a variation in designing tank towers on American railroads that the committee feels that the adoption of these standards and specifications is very timely. Many of the details in use in tank towers all over the country are very uneconomical, and without actual justification. These specifications and typical plans are offered as a final report, with the recommendation that they be placed in the Manual, and I will ask Mr. Knowles to read that last subject. (Mr. Knowles abstracted Appendix F.)

Chairman Dorley: *I move that the specifications for steel sub-structures for water tanks; specifications for timber sub-structures for water tanks, and the typical plans be adopted and published in the Manual.*

(Motion carried.)

Chairman Dorley: Before the committee is dismissed I would like to call attention to No. 5 of the suggested subjects for next year's study and report.

The pitting of boiler tubes is something that is becoming a very serious problem on American railroads, and the effect of this pitting represents one of the very large items in the expense of locomotive maintenance today. At first thought it might appear that the problem is one that the mechanical department should handle but the water service engineer is vitally interested in it, for the reason that pitting is generally ascribed to water condi-

tions. The most disquieting thing about the whole problem is that it is beginning to show up on districts where originally or years ago it did not appear, on districts where the water is either naturally good, or where the water is now being treated.

It is the recommendation of this committee that an arrangement be made to have a committee of the Mechanical

section of the A. R. A. and possibly a committee of the American Society of Testing Materials, co-operate with this committee in the handling of this subject. We think that it is about the most important problem that the water service engineer has confronting him at the present time.

(The committee was dismissed with the thanks of the Association.)

## Report on Economics of Railway Labor

*An investigation of methods of hiring maintenance of way labor shows a lack of systematic selection, and a tendency to return to labor agencies. Adverse effects of unsatisfactory housing conditions and intermittent employment are becoming more generally recognized. Engineering department is in charge of maintenance of way on most roads, with many men with engineering training coming into supervisors' position. Investigations on 52 principal railways indicates the estimated relative efficiency in September, 1920, only 67 per cent as compared with results obtained during the pre-war period from 1912 to 1916. Committee will continue investigations.*



C. E. Johnston  
Chairman

*C. E. Johnston, chairman of the committee, is completing his first year in this position and his third year as a member of the committee. He is representative of an increasing number of men who have risen through the engineering department to operating and executive positions in recent years. While chief engineer and for the last three years general manager of the Kansas City Southern, he has taken a keen interest in maintenance of way labor. Among his recent departures has been the organization of the foremen and higher maintenance officers on his road into a voluntary technical association, which meets monthly to discuss problems arising in their work.*

IN PREPARING THE SECTION of the report on plans and methods for obtaining labor for railways, a carefully prepared questionnaire was sent to 65 representative roads in Eastern, Western and Southern territory and to representative roads in Canada, in order to develop the existing practices throughout the country. This questionnaire developed that very little is being done by the railways in the way of specializing for the selection of their maintenance of way labor. The returns, when carefully analyzed, also show that for maintenance of way labor, at least, the railways have not availed themselves of the lessons which the experiences resulting from the war merely developed and intensified, and that no positive action has been taken to overcome the economic conditions which tend to create serious labor shortages at different seasons of the year.

Except for such labor as can be obtained locally, on approximately two-thirds of the roads throughout the country, the great army of excess workers required during the working season are, as a rule, recruited through labor agents, the majority of whom charge the men for securing the temporary job. There is no uniform practice as to the officer charged with responsibility for such matters, the tendency, however, seems to be to leave it, in a general way, under the engineer maintenance of way, where same exists. Where the services of these labor agents are utilized, it is the almost universal custom for the railways to obtain labor from various agencies, there being little tendency to accomplish this through a single source of supply.

As a general rule, railways do not pay bonuses or compensation to agencies for maintaining a stated supply of workers on their lines, but there are cases where this method has been followed, especially in times of labor stringency, the agency being responsible for maintaining the supply and being paid accordingly. Very few railways pay the agencies for securing their labor, it being customary for the labor agent to require the laborers to reimburse him for his efforts. This has resulted in a

great many abuses which are alike prejudicial to the interests of the worker and the railways.

The majority of the roads do not contract maintenance work, although there is a tendency in this direction on some of the more important items requiring extra gangs, or where special skill is required. Prior to the war, it was the practice for many roads to maintain labor agencies in the large labor centers, like Chicago, St. Louis, Kansas City, Omaha, etc. These were abolished during the war, but since the armistice was signed pre-war conditions have been restored and there has been a marked tendency to increase agencies, either wholly or partially supported by individual roads entering the larger labor centers.

Practically no limitation is placed on free transportation for transporting labor that cannot be obtained locally, and apparently no means has been found for protecting against the abuses resulting from the flagrant misuse of transportation furnished for the purpose of transporting this labor. In times of shortages, where labor cannot be supplied locally or obtained by labor contractors from territory tributary to the carriers, it is customary for most roads to pay fare for laborers recruited in off-line districts over other lines in order to bring them to their own road. It is not the practice of the roads to invoke statutory requirements against the misuse of transportation, as no method has yet been found whereby this may be effectively used. No effective means has so far been developed to protect against the worker who, having accepted free transportation, fails to accept service. When such worker leaves the service after a few days' (or hours') service, as is frequently the case, few roads make any attempt to retain part of his earnings as partial compensation for such free transportation.

The investigations of the committee, previously reported, have shown that the length of service for the casual worker is of exceedingly short duration, and the facility with which these transient workers may move from place to place is almost entirely responsible for

this condition. The questionnaire, however, developed that the majority of the roads appear not to feel that the abolition of free transportation for the casual workers would operate to stabilize labor. The replies reaching the committee indicated a general recognition of this widespread abuse in connection with the transportation of laborers, but few practical suggestions have so far reached the committee for its remedy. The popular one seems to be that some arrangement should be worked out by each road whereby laborers will be piloted from the source of employment to the particular job for which they are engaged. Where the services of boarding contractors are utilized to feed extra or floating labor, it is customary to afford free, reduced or limited transportation for their camp and food supplies, on approximately half of the roads reporting, the others assessing charges in some form or other thereon.

The replies indicate a decided effort is being made to furnish houses for regular section foremen at nominal rental, and some feeble efforts are being made to furnish better quarters than heretofore for common labor, but it is not general. The conditions in the Eastern section do not, as a rule, require this for its excess labor, whereas in the West it is necessary in some form on account of the long stretches of open country and the comparatively long distances between the towns. The majority of the roads furnish bunk houses for their laborers for which no rental is charged, but as a rule they consist of old car bodies. Some tendency for improvement in this direction is reported. It is the general practice for the railways to supply housing with wood or steel bunks for their floating, or semi-permanent labor, but the bedding, kitchen and other utensils are supplied by the boarding contractors, or the laborers themselves. It is also the general practice to supply cooks for track gangs, but no uniformity exists as to the number in proportion to the men employed. This applies to Bridge and Building Department and miscellaneous employees as well.

The majority of the roads reporting apparently contract with companies or individuals for feeding their common labor that is seasonably employed, the balance evidently believing that better results are secured where this is not done. There is almost an entire absence of trained supervision over food, sanitation or camp supplies for the workers. Where such supervision exists it is usually of a sporadic character and confined to local officers engaged in other duties. One large Eastern road, however, has assigned the feeding of its laborers to its dining car department and through it secures the benefit of the same sanitation and supervision of its food and camp equipment that is afforded to its patrons.

There is a marked difference between the practices of Eastern and Western roads in the matter of engaging and caring for labor. The general tendency of the Eastern lines is to so arrange their maintenance work that it shall be done with regular forces and minimize, as far as possible, the use of extra gangs, whereas, as a general rule, the Western roads depend on the extra gangs and casual labor to supplement the work of the sections, principally for relaying rail, ballasting and similar heavy work. There appears to be an almost universal appreciation by the roads of the serious effect that intermittent labor has on their organization and efficiency in maintaining the railways of the country. There is also a general feeling on the part of a majority of the roads that this can only be corrected, or at least minimized, by working out a more scientific method of arranging the maintenance of way program whereby large armies of

workers will not be made idle during a very considerable part of the year.

There is a universal feeling that before very much can be done by railways to stabilize labor, housing and living conditions must be more in conformity with the current practice of industrial and similar concerns, who seem very much in advance of the railways in this particular. Better sanitation, proper facilities for bathing and improved structures for housing the employee would appear to be the medium that will react powerfully to stabilize railway track labor. A better distribution of the forces so arranged as to give consideration to the comfort of the foremen and their families are a greater asset than is popularly supposed for increasing the efficiency, contentment and loyalty of the worker.

Changed working conditions have now served to intensify the importance of securing greater efficiency and a better selection of workers than ever before in the history of our railways. Section 15-A, of the Transportation Act, expressly stipulates that in determining the allowable return, expenditures for maintenance of way and structures and equipment must be so managed "as to secure honest, efficient and economic results." Manifestly if methods are employed which are wasteful or extravagant and as a result the principal item of railway maintenance (labor) is affected, the net return may also be affected. It would seem that it is well within the province of this Association to study the effect of poor methods in housing, transporting and otherwise caring for railway labor to the end that nothing of this kind may ever occur.

#### TRAINING AND EDUCATING EMPLOYEES

The committee has not completed its study of the subject-matter, consequently it is not in a position to make conclusive recommendations. Of the 60 roads reporting in answer to a questionnaire, 75 per cent have a divisional and 25 per cent a departmental organization.

Notwithstanding the large percentage for a divisional organization, approximately 72 per cent of the lines charge an engineer or the engineering department with the direct responsibility of maintenance of way. We also find approximately 65 per cent of the lines give preference to engineers, or men having engineering training, in selecting division officers in charge of maintenance of way. Fifty per cent of the total of roadmasters and track supervisors employed by the roads reporting have had engineering training. Our reference to roadmasters and track supervisors are those having charge of an average of 111 main track miles and 75 sidetrack miles.

Our investigations to date show approximately 99 per cent of track foremen are selected from common labor, the percentage of common labor being about as follows: Native white, 40 per cent; negro, 17 per cent; Mexican, 10 per cent; other foreign, 33 per cent.

The average length of track section in charge of a section foreman includes: 6.7 miles main tracks and 3.1 miles side track. Section motor cars are in use on approximately 69 per cent of the mileage reported. The investigation to date (September, 1920) indicated an estimated relative efficiency of only 67 per cent as compared with the results obtained during the pre-war period, or, say, 1812 to 1916.

Committee: C. E. Johnston (K. C. S.), chairman; C. H. Stein (C. R. R. of N. J.), vice-chairman; W. J. Backes (N. Y. N. H. & H.), A. F. Blaess (I. C.), B. M. Cheney (C. B. & Q.), C. C. Cook (B. & O.), W. R. Dawson (N. & W.), John Evans (M. C.), R. H. Ford (C. R. I. & P.), L. C. Hartley (C. & E. I.), W. R. Hillary (Penna.), C. B. Hoyt (N. Y. C. & St. L.), T. T. Irving (G. T.), R. E. Keough (C. P. R.), E. R. Lewis (M. C.), C. A. Paquette (C. C. & St. L.), W. H.

Penfield (C. M. & St. P.), J. R. Sexton (Erie), W. J. Towne (C. & N. W.).

### Discussion

C. E. Johnston (Chairman): The activities of the committee during the past year have been assembling information as a foundation upon which we might reach conclusions. The subjects assigned are, we think, so important, that we must go into all the details very carefully and endeavor to find some solution or arrive at some real honest-to-goodness recommendation in the handling of our maintenance labor, and what we have shown here in the report is to be taken as information. It is assembled with the idea of laying a foundation for our further study of the particular subject.

We have gathered considerable information with respect to maintenance of way labor, and I will admit it is hard to find a beginning point. We find that most lines have their own way of handling labor, and our questionnaires are giving us a very good line on the practices over the different parts of the country. In order to get the benefit of the views of the membership, we would like to invite discussion of these items, so first I will call upon Mr. Ford to read what we have said here with respect to the first subject.

R. H. Ford (C. R. I. & P.): I will take up some of the salient features on which the committee is very anxious to secure information. There are 3 or 4 things that have impressed us as being particularly important. One deals with the question of the misuse of transportation. Everybody recognizes this as a very flagrant evil, something that some united action will have to be taken to correct. No one was able to offer any real remedy.

The questionnaire has developed a great laxity of practice on methods of taking care of the men. We are paying so much for our track labor today, and the returns that we are getting must be measured by the ability of the laborer. Unless a man has good food and good housing conditions he will not deliver the work that he ought to do.

The Chairman: Are there any remarks or any suggestions to be offered the committee?

W. J. Backes (N. Y. N. H. & H.): The questionnaire would indicate that the majority of the railroads of the country have a divisional form of organization—that is, 75 per cent divisional and 25 per cent departmental. On the other hand, even though they have a divisional organization, the majority of the division engineers and roadmasters, or rather are engineers; that is, 75 per cent of the replies had engineers in charge of their maintenance of way departments; 65 per cent of the division engineers and 50 per cent of the roadmasters and track supervisors were men with an engineering training. Of course, in the east the tendency is to develop young engineers, and where the railroads take the time to give the men the training and establish a good line of promotion, we are able to attract some very promising young men into our service.

The territory covered by roadmasters and track supervisors generally averages about 11 mi. of main track and 75 mi. of side track. Possibly with the longer sections in the west, that average would be greater. The average age of roadmasters and track supervisors is 45 years. I think that on lines training young engineers you will find the average age probably nearer 35, between 35 and 40.

It has been very difficult to get young men to take positions as section foremen, although we have been able on some of the lines to get young men to take positions as general foremen, and those foremen have taken hold of the work very well.

The length of track sections under section foremen is 67 mi. of main track and 31 mi. of side track. That, I think, averages pretty well over the country, with the possible exception of where they have long motor car sections. Motor cars are now used on approximately 69 per cent of the mileage, and I believe there is a tendency for those who have had long motor car sections to shorten them.

I do not believe there is anything that we can do to strengthen our maintenance organization any more than to attract young men into our service who have had a good engineering education. That was the foundation of our work, and if we are going to develop the highest degree of efficiency we must have men who have the power to analyze the costs of their work and improve the methods of doing the work. Those railroads who have been doing experimental work, and using labor-saving devices are beginning to find out that material economies can be obtained through their use; it must be done intelligently. We cannot expect men to take these various mechanical devices without providing instruction and proper supervision in their use.

Chairman Johnston: We devote a great deal of thought and time and money to specifications for rails, ties and all other material, but we are overlooking to a considerable extent giving proper attention to labor and selecting the men who will develop into foremen and other supervising positions in the future. There seems to be a lack of uniformity all over the country—some do it one way, some do it another, some do not do it at all. Most of us do not do it at all, and I think that at the present time we are impressed with the importance of giving this entire subject a great deal more thought than we have in the past. We must get closer to the human side of labor. Personal contact probably will give us more results than anything else. Just how that can be brought about I am unable to say. We have a little organization on the line I am with called the Maintenance of Way Association. We have monthly meetings of our foremen and discuss things of interest—kind of a handshaking proposition—but at the same time we can notice a big improvement in feeling, in the fact that we are acquainted with the fellows. As Dean Potter said this morning, the engineering students think the time has come where they must be sorted and tested out. I think the time has come when our track laborer must be sorted and tested out if we are going to go along with the procession.

Earl Stimson (B. & O.): I hesitate to criticize the committee, because we assume that the committee represents the best thought on the subject that is in hand. In my opinion, the committee has the cart ahead of the horse.

The first thing to do when you undertake an enterprise is to establish what you are going to do and how you are going to do it, and then get together your supervising force that is going to handle the work, and train them. The last thing you do you get together your material and your men that are actually going to do the work and you are prepared to handle it. The committee get the men first, take care of them, keep them fed, and then educate them.

To my mind the first thing that should be undertaken is subject No. 3, "Study and report on standard methods for performing maintenance of way work, with the view of establishing units of measure of work performed." This elaborate preparation to get the men is more or less superficial and I think it is a mistake, as it applies to a very small percentage of the force which is employed regularly. We have men all the time. We do not have to organize a labor department, we do not have to build elaborate camps. We have plenty of men already to

start in and handle a piece of work in a well-organized way. On looking over the reports of the Committee on Economics of Railway Labor I find there has not been one single conclusion or one single recommendation that had been put forth, and this particular subject, which is the backbone of the whole thing, had been ignored. My suggestion to the committee is that it buckle down to work on subject No. 3 and arrive at a conclusion next year without indulging in the ancient and honorable American pastime of passing the buck. I suggest that the railroads take immediate individual action to improve the labor condition and to effect an organization to increase labor efficiency.

I think it is the duty of the committee to point the way and not leave it to the individual effort. The committee has been in existence four years and we have not gotten anywhere yet.

Chairman Johnston: It is all right to look at subject No. 3, with the view of establishing measure of weights of work performed, and say that is what we want. It is true, and we will get to it, and if there had been plenty of men during the past three or four years it would have been a comparatively easy matter to arrange for it. We have found it necessary to get men and show them what to do, and to measure what they are trying to do after we get them.

W. M. Camp (Railway Review): The trouble with the situation with regard to the maintenance force is that the men are not employed regularly all the year around. These men have families to support. The other classes of railway labor have work the year around. Under these circumstances you are not going to secure a class of men who will take pride in their work and who will expect to stay with that kind of work. I thoroughly believe that the point you have got to arrive at is to employ this labor regularly.

J. E. Willoughby (A. C. L.): On our road we have laid out our maintenance work so that the same number of men are employed throughout the year; that is, we do not increase or decrease the labor allowance on account of weather conditions. It is as much a part of the foreman's duty to see that his labor accomplishes sufficient work as any other thing of which he has charge. We hold the foreman responsible for the work accomplished. So far as the negro labor is concerned, the suggestion of the committee should be that the foreman be made responsible and measure the work of the foreman, and then require the foreman to see that the proper amount of work is done.

C. H. Stein (C. of N. J.): It was during 1916 and 1915 that this proposition of the equated track sections was considered, and we reached the conclusion that we could not do anything at that time, as the state of the art had not been advanced to a point where we could express conclusions in a mathematical form that would be substantial and effective in producing the results that this convention desired us to aim at at that time, and I want to say that we have been urged forward to make progress to stabilize the labor on American railroads. All of these subjects have been discussed and considered by previous committees and the labor situation was gradually becoming more satisfactory and the competency of labor was more nearly approaching a state of 100 per cent efficiency, but everybody knows what the experiences of 1917, 1918, 1919 and 1920 have been, and every man in this room knows but too well what the actuating forces have been which have been responsible for these restless conditions that have affected our general labor situation. The great factor in the problem is the human element, and I agree with one of the preceding speakers that this

has become not only a financial and economic problem, but it is becoming more and more as it was tending to do in '14, '15 and '16, a psychological problem. We have got to get nearer to the men. You must have approximately 100 per cent men in order to get any schedule or any program outlined or any method of equating track sections that will be productive of efficient and successful results.

R. G. Kenly (M. & St. L.): There are at least six months of the year in western Minnesota and the Dakotas when we operate with only a section foreman on a six-mile section. There is so little track work to be done that it would be difficult to arrive at any plan of dividing that work throughout the year so as to maintain our section force.

C. A. Morse (C. R. I. & P.): I have been in some labor meetings the last few months, where each railroad had an idea of its own, and no progress was made because there were as many ideas as individuals, and what we need to do is to give the committee the benefit of any suggestions we have for them to work on.

One of the subjects is in regard to trained men. On a railroad we have a lot of individual organizations; we have the water service gangs, the track gangs, building gangs, and signal gangs, etc., and it seems to me one of the things to do is to get the men in charge of these gangs into the habit of planning their work. The man who expends his money on track work or any other railroad work, hit or miss, cannot get the results that a man does who plans his work. We are up against the wage proposition, and in all these years of railroad in this country we have considered every man working on the section gang as a common laborer. The man who had been there 1 or 15 years got the same wages as a Mexican or Italian brought in who did not know the name of anything he had to work with. I think in this reconstruction period it would be a great thing if we could recognize the fact that there is such a thing as a skilled trackman, and part of our gang are skilled men, and I believe these men should be retained and the filling in part done with common labor. Probably one-third should be considered as skilled men and the rest put on as common labor.

J. L. Campbell (E. P. & S. W.): During the past 15 yr. we have been gradually improving the living conditions of our Mexican labor, and we are getting results every day. The tie shacks on our road in which the Mexicans lived at one time are being replaced at a reasonably steady rate with good buildings and improved labor conditions. We give prizes for flower gardens, and we do other work of that kind, which is producing good results.

Mott Sawyer (C. M. & St. P.): We do not need any system of standards to tell us that the men we are employing on the track do not come within hailing distance of doing a decent day's work and doing it in a proper manner, and something should be done to secure a better performance of duty by these men. Whether it will be by a system of bonus payment, or by some other system, possibly through welfare work, is difficult to say, but I do not see how you can stabilize section work throughout the year. But a means of improving the labor situation and giving us men enough to do our work efficiently and economically is a very serious matter, and I want to say that the committee in putting stress on means of recruiting and retaining labor is doing a very valuable work.

(The committee was dismissed with the thanks of the Association.)

## Report on Economics of Railway Operation

*The efficiency of the employees not regularly receiving comparative reports can be increased by furnishing them with reports and comparisons for their information and to create their interest. Data to be compared should be up-to-date, issued regularly and in the units of work or material with which the employee is most familiar. In order to increase the traffic capacity of a road detailed studies should be made embracing both road and terminal facilities, organizations and operating methods and covering such points as effective utilization of existing facilities, possible changes in operating methods and minor additions to secure immediate increases.*



L. S. Rose  
Chairman

*L. S. Rose is completing his first year as chairman of the committee, of which he has been a member since its organization in 1918. His varied experience in railway service particularly fits him to direct the work of this committee. As division engineer of the Big Four for six years and later as signal engineer at a time when an extensive program of grade reduction and signal construction was under way, he was brought into contact with the economics of operation. More recently as valuation engineer and for the last two years as assistant to the general manager, he has of necessity continued these studies under the changing conditions of today.*

THE COMMITTEE presented progress reports on the following subjects, none of which were recommended for insertion in the Manual, but offered solely as information: Subject (1) Methods for Increasing Efficiency of Employees by Furnishing Them with Reports and Comparisons, given in Appendix A; (2) Methods for Increasing Traffic Capacity, in Appendix B; and (4) Effect of Speed of Train Upon the Cost of Operation, in Appendix C.

Committee: L. S. Rose (C. C. C. & St. L.), chairman; G. D. Brooke (B. & O.), vice-chairman; J. B. Babcock, 3rd, L. W. Baldwin (I. C.), J. M. Brown (C. R. I. & P.), A. G. Boughner (M. K. & T.), J. W. Burt (C. C. C. & St. L.), Maurice Coburn (Penn.), F. W. Green (St. L.-S. W.), H. B. Grimshaw (S. A. L.), V. K. Hendricks, E. T. Howson (Railway Age), R. B. Jones (Penn.), E. E. Kimball, H. A. Osgood (Wabash), R. J. Parker (A. T. & S. F.), Dean Wm. G. Raymond (Univ. of Iowa), Mott Sawyer (C. M. & St. P.), J. E. Teal (B. & O.), C. C. Williams (Univ. of Kansas), Louis Yager (N. P.).

### Appendix A—Increasing Efficiency of Employees by Furnishing Reports and Comparisons

The term "employee" in this subject refers to those employed in minor positions on the railroad who do not see regularly the comparative reports sent out from time to time of various statistics. The methods suggested are that comparisons of the effective work of individuals or groups of individuals or employees be tabulated and published; these comparisons to be of subjects in which an employee is engaged. The purpose of these comparisons is to stimulate friendly rivalry which may be developed in practically every line of railroad work. These comparisons should be discussed with the employee, in groups of his fellow-workmen, for the purpose of securing their criticism and advice, recognizing their knowledge and insuring their interest. Men are interested in their own line of work; in fact, they are inclined to think all other lines are subordinate to theirs. This idea should not be discouraged.

While the final result to be secured is the cost, the units for comparison should be those in which the employee thinks; for instance, if a section foreman is asked about the number of ties he can put in, he will reply, so many per hour or per day; or a locomotive fireman will keep tally on the number of scoops of coal he uses on a run for his comparisons. The data collected should be published at least once per month, in some instances oftener. During the season when the subject under discussion is being actively engaged in, such as insertion

of ties, reports should be made every week. The reports should also be kept up to date, and if the data are not furnished by the employee promptly, inquiry should be made to ascertain the reason for the delay. If this is not done, the employee will think it has been forgotten, interest will die out, and soon there will be no records.

Methods for keeping the records should be published to prevent misunderstandings, and to insure uniformity. Some data are published by presenting a tabulated statement of facts, others by graphic charts. The range of territory covering the performances should not be too great, for people are more interested in the work of their neighbors than of those a thousand miles away, and the comparison of the work will probably be on a more equitable basis.

### Appendix B—Increasing the Traffic Capacity of a Railway

Two studies have been presented, the object of the first being to outline steps which will establish whatever weak points there may be in the organization of a railroad and the ways for improving operation so as to obtain increased capacity with the existing facilities or with slight modifications of them.

The second is a discussion of the physical elements which affect the traffic capacity. That is, it begins with the assumption that new facilities are required and a study is to be made to determine what these facilities shall consist of. This study was undertaken late in the year and is incomplete, due to lack of time to secure the data necessary to develop it to the point of determining where new facilities are required or to forecast what the benefits of the new improvements will be. It is proposed as a part of next years work to collect such data from actual operations on existing railroads and to use it in the continuation of this division of the subject.

In considering the means of increasing the traffic capacity of a railroad, the logical first step is an examination to ascertain

- (A) If the facilities as they exist are being utilized to the maximum capacity;
- (B) What changes, if any, in methods of operation will produce increases of capacity;
- (C) What minor additions or alterations to facilities can be quickly made which will produce increases of capacity.

For this examination the engine district—embracing two terminals and the one hundred miles more or less of line between them—is the most suitable unit. If the

problem should have to deal with more than one such district, each will have to be examined of itself and then with the results so obtained they must be studied together, each in its relation to the adjoining districts and to the line as a whole, and thus by progressive study the examination completed for the entire railroad.

The facilities of an engine district consist roughly of the main tracks, passing tracks and other sidings, yards, telegraph offices, signals, water stations, engine houses, ash pits, coal chutes, etc., the locomotives assigned to the district, the locomotive repair shops, and the special equipment.

The detailed studies should embrace both road and terminal facilities, organizations and operating methods or such portions of them as the preliminary investigation may determine is necessary. They should be made by consulting the train sheets and the various daily and periodic reports of operating performance and by making comparisons with the performance during previous periods, by suitable observations of actual work and by free discussion of the problems and conditions with the officers in charge of the operations.

The problem is peculiar for the reason that the results which might be expected from theoretical considerations of the factors involved are greatly in excess of the results which have been obtained in actual operation. On this account it has been difficult to obtain the best facilities when needed, largely because of the fact that the true conditions could not be set forth. The purpose of this discussion is to obtain a conception of the physical elements which determine the traffic capacity of a line and to show how operating results may be analyzed so

as to form the basis for comparing the costs of providing new facilities with the financial benefits to be gained therefrom. Such analyses will be of value in demonstrating the feasibility of proposed undertakings for increasing the traffic capacity of a given line.

### Discussion

L. S. Rose (Chairman): E. T. Howson will present Appendix A, "Method for Increasing Efficiency of Employees by Furnishing Them With Reports and Comparison to Inform and Interest All Concerned."

(Mr. Howson presented the report.)

Chairman Rose: G. D. Brooke will present Appendix B on "Methods for Increasing the Traffic Capacity of a Railway."

(Mr. Brooke presented the report.)

Chairman Rose: The Appendix of the report on the "Effect of Speed of Trains on Cost of Operation" will be presented by C. C. Williams.

(Mr. Williams presented the report.)

Chairman Rose: J. E. Teal will present that part of the report on "The Effect of Speed of Trains on the Cost of Operation."

(Mr. Teal presented the report.)

The Chairman: This report does not require action for adoption in the Manual, but is before you for discussion. I hope the good work which this committee has done will be appreciated by an active interest on the part of the members. It is a matter which is of great interest to nearly all of us.

(The committee was dismissed with the thanks of the Association.)

## Report on Economics of Railway Location

*Curves are presented for use in estimating freight and passenger train resistances at speeds ranging from 35 to 50 and 5 to 75 miles per hour, respectively, and temperatures of 35 deg. F. and upwards. In studying economy of electrification, conclusion is drawn that, taking into consideration the heavy fixed charges of investment, no general conclusion can be given at this time as to the relative economy of electric and steam operation. Each case must be considered by itself, taking into consideration all elements of cost and expense, both special and general, as well as operating conditions and the public comfort and safety.*



C. P. Howard  
Chairman

*C. P. Howard is rounding out his first year as chairman of the committee, although he was vice-chairman for seven preceding years and has been a member of the committee for ten years. He has taken a prominent part in guiding it through its more or less turbulent career. He has contributed a number of monographs on subjects allied with the work of the committee and wrote an extended review of the Manual, which was published in the October issue of the Bulletin. He has been identified with the federal valuation work for several years, being senior civil engineer in the Division of Valuation of the Interstate Commerce Commission at Chicago.*

**I**N APPENDIX A the committee submitted two proposed changes in the Manual to cover Sections 5 and 6.

In Appendix B the committee presented a report on the resistance of trains between 35 and 75 miles per hour, with diagrams, tables and conclusions recommended for adoption and inclusion in the Manual. The committee submitted in Appendix C a report on economics of location as affected by electric locomotives with conclusions recommended for adoption and inclusion in the Manual.

Committee: C. P. Howard (I. C. C.), Chairman; A. S. Going (G. T.), vice-chairman; F. H. Alfred (P. M.), R. N. Begien (B. & O.), Willard Beahan (N. Y. C.), Edwin J. Beugler (West. Church Kerr), W. J. Cunningham, C. T. Delamere (C. P. R.), A. C. Dennis (Cons. Engr.), W. A. James (C. P. R.), Fred Lavis (Cons. Engr.), E. H. McHenry,

Edward C. Schmidt (U. S. A.), H. C. Searls, A. K. Shurtleff (Ass't Sec.), C. H. Splitstone (Erie), C. W. Stark (N. Y. N. J. Com.), M. F. Steinberger (B. & O.), John G. Sullivan (C. P. R.), Walter Loring Webb (Cons. Engr.), M. A. Zook (I. C. C.).

### Appendix B—Resistance of Trains Running Between 35 and 75 Miles per Hour

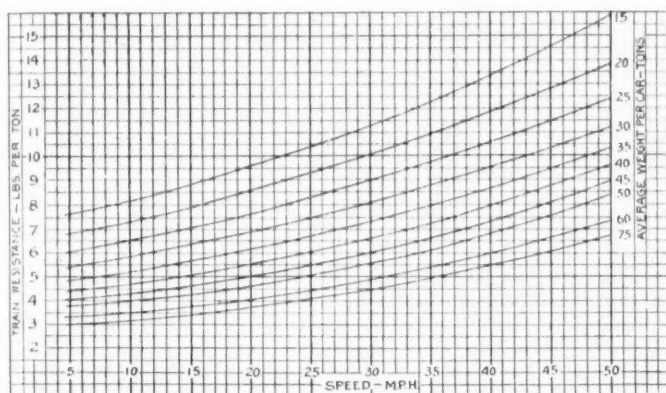
Throughout this report the terms "resistance" and "train resistance" mean the number of pounds of tractive effort required for each ton of the train in order to keep it in motion on straight and level track, at uniform speed. This resistance is only that of the train behind the locomotive tender—the resistance of the locomotive and tender, themselves, is not included.

The results here presented relate to trains running on good track and in moderate weather when the temperature is above 30 deg. F. and the wind velocity not over 20 miles per hour. Poor track, extremely low temperature, and high winds all increase train resistance; but there is not yet available enough information to enable the influence of any of these factors to be evaluated. The influence of low temperature is probably the most important, and some allowance should be made for it in attempting to predict resistance during extreme winter weather.

It should be emphasized that the resistance of both freight and passenger trains depends not only upon speed, but upon the average weight of the cars composing the train. In order to predict resistance at any speed, the average weight of the cars must be either known or assumed.

#### FREIGHT TRAIN RESISTANCE

The tests were made with a variety of trains in regular freight service upon well-constructed and well-maintained main-line track, 94 per cent of which was laid with 85-lb. rail, the remainder being laid with 75-lb. rail. The



under conditions of air temperature and wind velocity such as prevailed during these experiments.

### Conclusions

(1) Fig. 1 may be used in estimating freight train resistance at speeds from 35 to 50 miles per hour for Class A rating and temperatures of 33 deg. Fahr. and upwards.

(2) Fig. 2 may be used in estimating passenger train resistance at speeds from 5 to 75 miles per hour and temperatures of 35 deg. Fahr. and upwards.

### Appendix C—Economics of Location as Affected by Introduction of Electric Locomotives

Railroad electrification, while most desirable from the point of view of the conservation of our fuel resources, is a matter than can not be undertaken wholesale, for several reasons. First, the capital outlay would be enormous; second, each individual railroad system or even subdivision is a problem in itself, to be judged on its own merits.

The modern steam locomotive by the use of brick arches, feed water heaters, superheater, stokers and trailer boosters has had its efficiency increased practically 50 per cent. At the same time its size and capacity have increased with this advance, and the question arises wherein the electric locomotive is superior. From an operating standpoint it has a number of minor advantages. It eliminates the turntable; cuts down standby losses; removes the delay at water tanks and coaling stations; its availability for service is very much greater, and its maintenance is considerably lower. Its capacity is increased with cold weather—the reverse of the steam engine. Its simplicity of control relieves the crew from many duties necessary on a steam engine, and permits closer observation of track and signals. When properly designed, it is much easier riding and can have a more uniform distribution of weights with less nosing and track pounding; all of which tend to lower track maintenance. In addition there is one great inherent advantage which the electric locomotive possesses, namely, the ability to concentrate large amounts of horse power under single control.

In steam railway operation each train has its own source of power, which has no relation to the propulsion of the other trains on the line. In electric railway operation every train draws its power from one or more centrally located power houses.

### ADVANTAGES OF ELECTRIC OPERATION

The entire weight of the electric locomotive can be and frequently is on the drivers, while but 65 per cent to 75 per cent of the steam locomotive (except the switching type) is thus utilized. An electric locomotive allows an increase in tractive effort without a decrease in speed. A limiting factor of the horsepower output of a steam locomotive is the steaming capacity of the boiler, as well as the amount of coal per hour which the fireman can throw into the grate continuously throughout the shift. (The latter does not apply in the case of automatic stoker fired engines.) A comparison between the maximum weight of train permissible with the steam locomotive and the standard weight of train prescribed for electric locomotives shows there is an increase over steam operation of from 18 per cent to 25 per cent. The tractive effort and the motor capacity are far greater in the electric locomotives, due to the more effective application of power.

An advantage which is ascribed to electric operation is the benefit derived from the elimination of work at terminals necessary when steam locomotives are used. With

the same service to be handled there should be less electric locomotives necessary than steam locomotives, unless there are peculiarities in the service itself. It is maintained that under electric operation there is a saving in fuel of 50 per cent to 65 per cent. Assuming it is correct in stating that the power house consumes but one-half as much coal for the same number of ton miles, the cost of power would be more than one-half of the cost of coal. There are other factors entering powerhouse costs which do not appear in the cost of coal. The cost of other supplies than coal are the cost of power house labor, and the expense of maintaining the power house and its equipment, all of which are items of no mean importance. Another factor is the transmission loss between the power house and the locomotive. While engine house expenses of steam locomotives are important factors they are insignificant in electric operation. In freight service there is another factor tending to reduce further the cost under electric operation. Two or more electric engines coupled together may be operated by a single crew. This possibility of double heading without additional engine crews results in a considerable saving. Unit costs of electric operation decrease as the volume of traffic increases, whereas the unit costs in the case of steam operation remain comparatively constant.

### DISADVANTAGES OF ELECTRIC OPERATION

As regards the disadvantages of electric operation, the most important objection is the enormous first cost and the heavy fixed charge which that involves.

Electric equipment is more costly than steam equipment. Electrification must not only bring about economics, but very large reduction in operating cost in order to prove itself economical. The electric locomotive is a piece of transforming apparatus which receives its power from an outside source, and is, therefore, subject to overloads. The steam locomotive is a self-contained mechanical unit and it is hardly possible to injuriously overload it.

There is additional danger to the lives of the employees and others. This is, of course, much more serious when the power is transmitted at higher voltage and where freight and switching service as well as passenger is operated by electric power. Another argument against electric operation is that which deals with the additional liability of train delays. In addition to equipment failures which occur on both steam and electric service, there are failures of the transmission lines.

With electric traction the territory protected with automatic block signals of the usual continuous current track circuit battery type will have to be replaced with alternating current track circuit apparatus, because the use of track circuits with propulsion currents in the rails requires selective apparatus to prevent false indications. Normal traffic cannot be exceeded for periods of long duration unless the system has been designed to take care of maximum traffic, which greatly adds to the capital charge.

Unless other load than the railway is carried on the generating stations on small systems a poor load factor is liable to be encountered which adds to the capital charge through maintenance of under-loaded equipment. It is more susceptible to the vagaries of the weather, as in addition to the snow, washouts, and other conditions that affect steam operation, lightning is apt to interrupt the electrical operation.

Steam locomotives are strictly interchangeable and can be moved from division to division, as the necessity for varying motive power capacity develops. Electric locomotives are limited in their field of operation strictly to

electrified track. Traffic must be handled as circumstances require. It cannot be spaced conveniently for power demands, but the terminal yards must be cleared as the cars accumulate.

#### GENERAL

As to the comparative efficiency of the two types of locomotives in the matter of failures, the electric locomotive seems to hold its own. There are certain factors, however, which within the last few years have made the steam locomotive a more formidable competitor of electrification. These are, particularly, the various outside valve gears, the superheater, the brick arch and the automatic stoker, which have increased the tractive power and sustained hauling power of an engine as well as resulting in greater economy of fuel and water.

From available data on the results of heavy electrification it would appear that the ton miles moved by six and one-half pounds of coal in a steam locomotive is approximately equal to that which can be moved by one kilowatt hour delivered from the power station, varying, of course, with the quality of coal. In a great majority of cases the profits from electrification must be realized indirectly rather than directly—increased track capacity, postponing second tracking or the like.

Steam railroads will generally consider electrification favorably when the reduction in operating expenses will pay the interest on the necessary investment, provided the capital requirements can be met, leaving the unevaluated advantages to be gained by electric operation as an additional asset. Also, when the traffic capacity is imperative and this can only be supplied by a large additional expenditure or by electrifying. Track maintenance will under present conditions be generally increased, not only by the additional charge for the maintenance of overhead or third rail contact and distributing systems, but also by the destructive effect upon rails and fastenings of the greater impacts, due to the imperfect cushioning of the heavy weights of the electric motors.

#### RISE AND FALL

The unit values of the several minor classifications under this head will be determined as before with modified factors of cost. Two new elements will be introduced and must be included in the final results, viz.: the time and temperature limitations of the electric motor and the possibilities of regeneration of power on descending grades. The cost of Rise and Fall will be reduced if advantage is taken of opportunities for the regeneration of power by trains on descending grades. The value of such regeneration is considerable under proper conditions. The actual percentage of power which can be utilized will depend upon the length and steepness of incline, total length of electrified section and the number and distribution of daily trains. Regenerative braking does not become economical except on long mountain grades.

The effects of rate of grade and of rise and fall are more closely inter-related in electric than in steam operation. Train tonnage ratings in steam service over lines of moderate grades are often determined by the average resistance of the division and the boiler horsepower of the engine rather than by the resistance of the maximum grades. If the inherent characteristics of the electric motor permit the development of higher speed and horsepower, within its nominal rating, then the resistance of the maximum grade may become the limiting factor, and its rate becomes economically important. In heavy service, and especially on mountain grades, the economic value of electric operation may be quite high, as it is possible to add engine units without adding engine crews.

Other differences affecting unit costs differ more in degree than in kind.

#### CONCLUSION

Taking into consideration the heavy fixed charges of investment, no general conclusion can be given at this time as to the relative economy of electric and steam operation. Each case must be considered by itself, taking into consideration all elements of cost and expense, both special and general, as well as operating conditions and the public comfort and safety.

#### Discussion

(C. P. Howard (Chairman) presented and outlined the report.)

A. S. Going (G. T.) presented the first subject, on "Make a Thorough Examination of the Subject Matter in the Manual, and Submit Definite Recommendations for Changes."

Chairman Howard: *I move the adoption and insertion in the Manual of the text under Appendix A.*

(Motion carried.)

Chairman Howard then read Appendix B—"Resistance of Trains Running Between 35 and 75 Miles Per Hour."

Chairman Howard: *I move that these conclusions be adopted.*

(Motion carried.)

Mr. Going: Referring to Appendix C, this information was taken from some of the data that is issued by the General Electric Company; in fact, most of the data that I have used in compiling this was information that we gleaned from different reports by Mr. Armstrong and other gentlemen that are with the General Electric Company.

C. F. Loweth (C. M. & St. P.): Many electric locomotives are built as two different units—they can be operated as independent units—but when you do that you are up against the enginemen's organization, and they want the double crew.

E. B. Katte (N. Y. C.): It did not occur to me that this report would take up operating features and comparison with steam locomotive operation, therefore, I have not read it. I find a great deal to criticize. The explanation from the chairman of the sub-committee that it is a compilation of information supplied by the General Electric and presumably other companies, perhaps manufacturers of steam locomotives, makes plain some of these statements, as for instance, this statement concerning insulators.

In fifteen years of operation on the New York Central we have broken many insulators, but we have never had the whole railroad tied up because one insulator was broken. It might cause a delay of four or five minutes to locate that particular insulator and isolate that feed-rail. No railroad built nowadays depends upon one feed-rail. I notice also a reference to electric operation being more apt to be interfered with by the vagaries of the weather, that lightning is apt to interrupt it. Lightning occasionally interrupts it, but very seldom, and other climatic conditions affect electric operation less than they do steam operation. The record of the New York Central on storms is far better than any of the adjacent steam companies. I hope that this report will be taken with a grain of salt.

May I suggest that when you write your next report you use the facilities of this Association and call upon the Committee on Electricity. I think this is more a report on electricity than on economics of railway location.

(The report was received as information and the committee excused.)

## Report on Shops and Locomotive Terminals

The design of car shops is influenced by the consideration of track centers, safe clearances for cars, material handling, headroom, lighting, heating, etc. In studying this subject the committee investigated a large number of structures in use on various roads and presented plans of a great many of them. Data concerning ash pits were gathered from practically all railways in the United States and Canada, covering such features as the number of locomotives handled, the estimated cost, and the advantages and disadvantages. Many types are employed and nearly every type in common use is highly favored by some roads and adversely criticized by others.



F. E. Morrow  
Chairman

F. E. Morrow is the first chairman of this new organization. As the attention of the committee is devoted largely to the subject of terminals it is fitting that it should be headed by a man occupying the position of chief engineer of a terminal railway, in which capacity a larger proportion of his time is devoted to terminal matters and terminal structures than would ordinarily be the case. Previous to his promotion to chief engineer he occupied the positions of principal assistant engineer and assistant chief engineer, in which capacities a large part of his time was occupied in matters of design which now serve him in good stead.

IN APPENDIX A THE COMMITTEE submitted certain studies for information on the design of car shops. It also reported progress on the subjects of (1) ashpits, (2) engine houses, power plants and shop extension, (3) storehouses, (5) design of coaling stations, and (6) typical layouts for storage and distribution of fuel oil, including fuel stations between terminals.

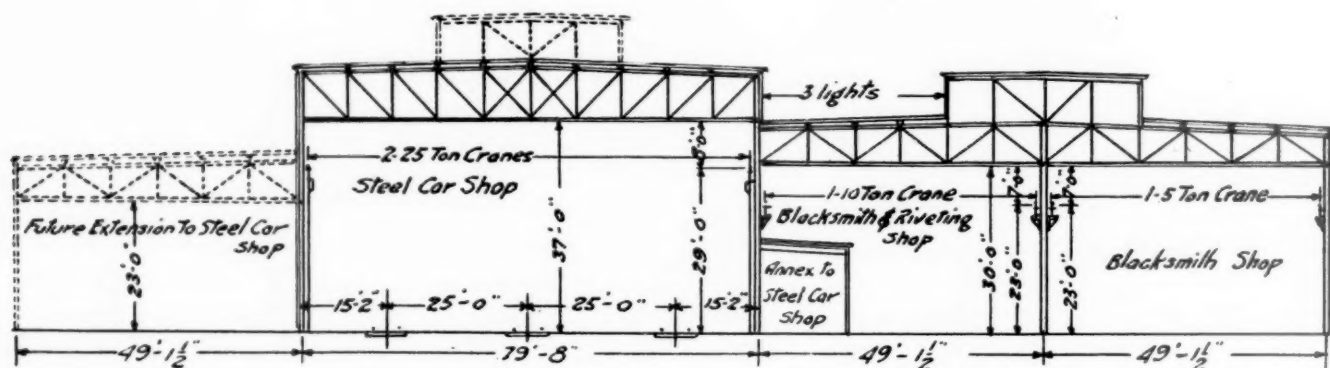
Committee: F. E. Morrow (C. & W. I.), chairman; A. T. Hawk (C. R. I. & P.), vice-chairman; C. N. Bainbridge (C. M. & St. P.), G. W. Burpee, Leland Clapper (D. & I. R.), C. G. Delo (C. G. W.), G. H. Gilbert (Sou.), Walter Goldstraw (G. T.), J. G. Gwyn (D. & R. G.), E. M. Haas (Austin Co.), R. J. Hammond (B. & M.), G. W. Harris (A. T. & S. F.), E. A. Harrison (A. T. & S. F.), J. L. Haugh (U. P.), L. P. Kimball (B. & O.), W. T. Krausch (C. B. & Q.), M. A. Long (B. & O.), J. B. Maddock, Adam Ritter (Sou.), L. K. Silcox (C. M. & St. P.), John Schofield (C. N. R.), E. M. Tucker, A. M. Turner (C. C. C. & St. L.).

### Appendix A—Design of Car Shops

Many railroad companies find it desirable to provide shops for handling repairs to freight cars either on account of climatic conditions, legal requirements, or the belief that the provision of such shops will result in a

tee has collected a considerable amount of data to which it has devoted careful study, and as a result presented general drawings of several plants actually in service and several proposed for the future, as an outline of actual possibilities in construction as experienced at this time. It was noted that, in general, the layout of many plants had been governed by existing property and trackage limits, and this condition is one which will probably be encountered even more seriously in the future, except where very extensive plants in new localities are contemplated.

In reviewing freight car repair layouts throughout the country, it was found that they divide themselves into two general classes: light repairs and heavy repairs. The first-named group consists of equipment receiving running repairs given in transportation yards with trains under blue flag protection, where the safety appliances, doors, brake equipment, lubrication, brasses and minor truck repairs receive attention. Further to this, light repairs are handled, but require switching of the cars out of trains. Under this heading, cars are spotted on improvised tracks, where wheels are changed, brake rigging repaired, draft rigging and couplers replaced, and cars ne-



Cross Section of a Steel Car Shop

higher degree of efficiency. Arguments advanced in favor of such shops are that their provision will insure a better grade of workmanship, a lower rate of labor turnover, and that cars repaired in a shop will give better service.

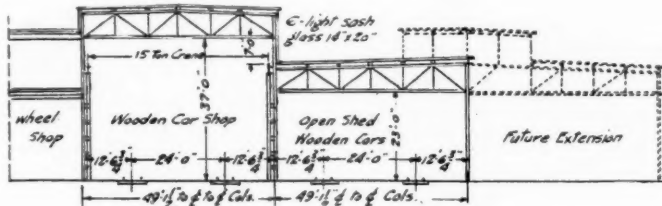
In order to facilitate the design of car shops where their construction may be necessary or desirable, the commit-

tee has collected a considerable amount of data to which it has devoted careful study, and as a result presented general drawings of several plants actually in service and several proposed for the future, as an outline of actual possibilities in construction as experienced at this time.

Sheds or shops are not to be recommended as practicable at this time for the light repair work mentioned above, because of the frequent switching necessary and

the further fact that many hundreds of cars in this class are worked upon each day, depending upon the amount of business handled through any territory, and the number requiring repairs has little fixed relation to a road's ownership.

In the case of heavy repairs, however, shops may be desirable at certain points, especially when considered in conjunction with the power, tool and handling equipment necessary to intensive production. There are three subdivisions into which heavy repairs may be classed, namely: Medium repairs, consisting of moderate attention to trucks, underframes and superstructure with entire re-



Cross Section of a Wood Car Shop

painting; heavy repairs, occasioned by severe wreck damage or extreme deterioration; and rebuild, where cars are strengthened and made modern in construction through the application of steel underframes, ends, roof, etc. Where it is possible, most railroads prefer to do heavy repair work on their own cars, due to having suitable standard material, and the further fact that cars can be segregated by series and the work standardized. There are practical reasons requiring the rebuilding of foreign

named in section No. 1, it is desirable, considering present and future practice, to allow 60 ft. per car. Railroads using wider track centers, such as 30 ft. with material tracks, and 22 ft. without, usually only employ 50 ft. per car due to rearrangement of work.

(3) **Supply Tracks:** Standard gage seems to be preferred throughout the country, due to the ease in handling wheels and the usual design of section push car upon which material can be carried. Further to this, erecting shops can be supplied with standard freight car loads of heavy material, such as underframes, sills, etc., which is not possible with narrow-gage tracks.

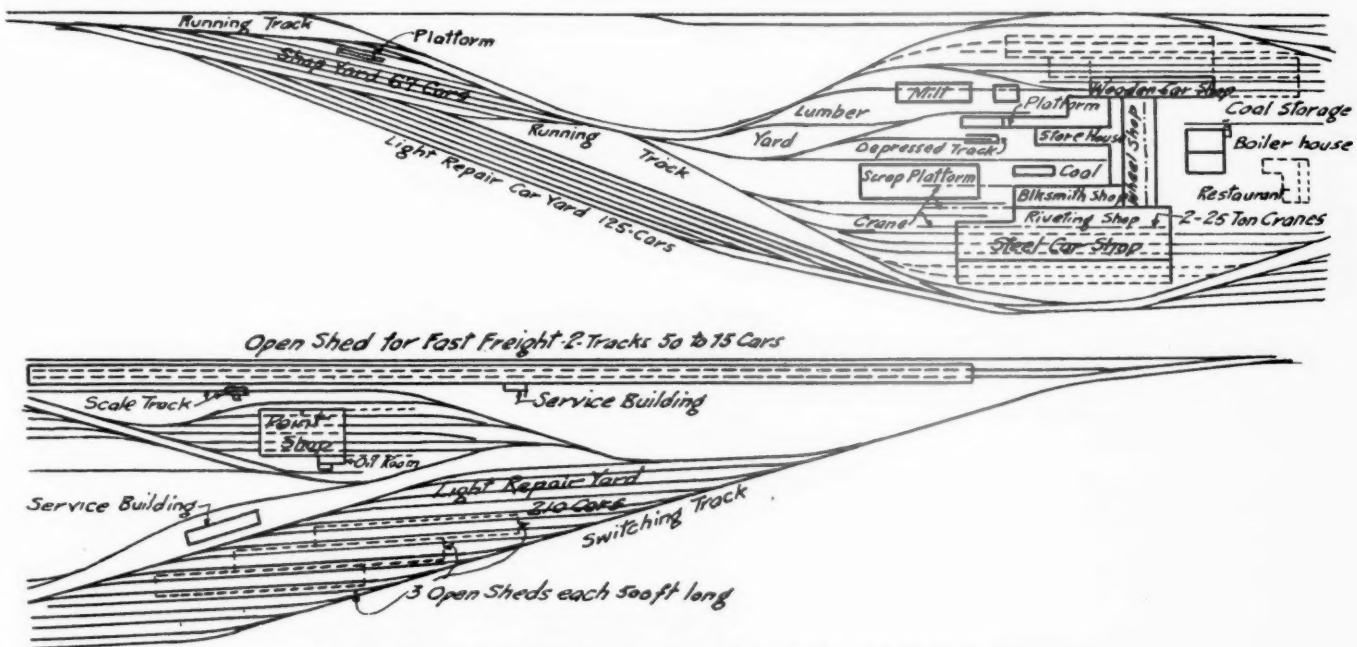
(4) **Clearances:** It is recommended that a minimum clearance of 10 ft. from center of track to face of pilasters and 12 ft. from center of track to face of wall.

(5) **Headroom:** Measuring from top of rail, overhead clearance in shops where cranes are not employed should be 20 ft. minimum, with 22 ft. desirable. Where cranes are used, clearance should be not less than 25 ft. unless careful study of local operating conditions should dictate a smaller dimension advisable. In mentioning clearance, it is the purpose to define it as the exact clearance possible either from the crane hook or crane cage or girder, whichever forms the limiting element and the farthest downward projection. Shops designed with cranes should be limited to include bays not to exceed four repair tracks.

(6) **Doors:** The minimum dimension for end doors in car shops should be 13 ft. wide and 17 ft. high, obtaining as large a door on supply tracks as clearance and general construction will permit.

(7) **Paint Shops:** Separate accommodation in line with the normal movement of cars through shops should be provided and installed in such a way so that equipment can be handled expeditiously and prevent blocking repair tracks.

(8) **Expected Increase:** Full consideration should be given to expected increases in demand and future extensions which can be foreseen. In cases where shops are constructed with traveling cranes, it was felt advisable to recommend that runways be advanced beyond the covered space which will provide for flexibility of operation and permit men to work either out-doors or in-doors as local conditions may govern;



Typical Layouts of Car Repair Facilities, Yards and Shop Buildings

cars occasioned by the handling lines' responsibility, but this only represents a small percentage of the total.

Where a railroad owns a sufficient number of steel cars to justify the expense, a special shop should be given consideration for this purpose. From what the committee could observe, based on experience throughout the country, it recommended the following:

(1) **Track Centers:** In cases where material tracks are employed, 24 ft. centers are recommended and in cases where material tracks are not used, 18 ft. centers as a minimum.

(2) **Space Allowance per Car:** With the track centers

also will assist in the handling of material and the adjustment of loads in cars.

(9) **Handling Material for Effective Service:** Every possible means should be provided for a prompt and economic handling of material through the application of necessary cranes, hoists, mono-rails, supply tracks, runways, and storage space, all located with the single purpose of concentrating work and materials into definite groups.

(10) **Lighting:** Ample lighting is essential. Construction of roof and walls should be such as to admit the maximum amount of natural light and ample artificial light should be provided, which, in a general way, should amount to just as much as is required in usual locomotive shop practice. In-

terior walls and ceilings should be painted and maintained as nearly white as possible.

(11) **Heating:** The question of proper heating should be carefully studied out so as to maintain a temperature of between 40 deg. and 50 deg. Fr. in the shop itself, whereas in adjacent machine sections and other points requiring operators remaining stationary at tools, etc., a temperature of 60 deg. to 70 deg. is preferable. The expense permissible in providing a heating plant will be governed largely by the form of construction to be employed. During cold weather it should be remembered that equipment has to be thawed out when brought into the shop in order to facilitate repairs, so that the heat should be delivered as near the floor line as practicable and well distributed so as to avoid drafts.

#### Discussion

Chairman Morrow: The committee has only had this year for the study of these subjects. It has been actively

engaged in collecting information as to prevailing practice on these subjects, but does not at this time present any definite conclusions as to recommended practice. This work is progressing, but has not yet reached the stage of compiling a report.

The Chairman: This is the first report of this newly-created committee, and I think they are to be congratulated for having brought together a great deal of good basic information which will be built on in coming months. It is a class of work on which I think we should place a great deal of importance, because it correlates the problem of the mechanical department with the engineering department.

(The committee was dismissed with the thanks of the Association.)

## Report of Special Committee on Standardization

*Standardization, considered solely in relation to railroad requirements, has been, because of its nature, scope and diversified application, the result of growth and will continue to be. Material benefits will accrue to the roads from standardizing such materials, tools, etc., as track spikes, track bolts, track jacks, switch lamps and track and ballast tools of all kinds. Work of standardization can be done by detailed handling of each article until a final design suitable to both producers and consumers is reached. A list of 43 different classes of articles is recommended for standardization by 10 different committees. Co-operation between committees is essential.*



E. A. Frink  
Chairman

*E. A. Frink is the chairman of this committee, which was organized two years ago and includes in its personnel the chairmen of all the regular committees. It is largely because of the interest which he took in this subject as a member of the Board of Direction that the committee was formed. It goes without saying that Mr. Frink is an enthusiast on the opportunities for good work by this committee, but in the absence of well defined policies on the part of the various interests involved it is to be expected that progress will be slow. Mr. Frink is one of the closest students of the committee reports, especially matter proposed for inclusion in the Manual.*

**S**TANDARDIZATION—CONSIDERED SOLELY in relation to railroad requirements—from its very nature, as well as its wide scope and diversified application, has been in the past and must continue to be the result of growth, but its natural growth can and should be advantageously accelerated by judicious assistance. Material benefits will accrue to the railroads from standardizing track spikes, track bolts, track jacks, track and ballast tools of all kinds, rail drilling, switch lamps, etc., and this Association should lead in the work. This can be done by detailed handling of each article until the final design, acceptable to both producers and consumers, is reported to this Association. Our experience would lead us to believe that a purchasers' market would expedite results.

The committee recommended that all standards adopted by the A. R. E. A. be known and designated as R. E. standards. In case of the adoption of standards originated by other bodies, due credit should be given to the originators. In accordance with instructions a list of recommendations was prepared for the Committee on Outline of Work and attached as Appendix A.

Committee: E. A. Frink (S. A. L.), chairman; J. R. W. Ambrose (Tol. Term.), vice-chairman; F. L. C. Bond (G. T.), A. Crumpton (G. T.), A. F. Dorley (M. P.), W. T. Dorrance (N. Y. N. H. & H.), W. J. Eck (Southern), J. M. R. Fairbairn (C. P. R.), W. H. Hoyt (D. M. & N.), Edwin B. Katte (N. Y. C.), F. R. Layng (B. & L. E.), B. H. Mann (M. P.), G. J. Ray (D. L. & W.), H. L. Ripley (N. Y. N. H. & H.), O. E. Selby (C. C. & St. L.), H. M. Stout (N. P.), C. M. Taylor (P. & R.), W. P. Wiltsee (N. & W.), J. J. Yates (C. R. R. of N. J.).

#### RECOMMENDED STUDIES ON STANDARDIZATION

The following list of articles was selected for studies on standardization and where other committees are to be consulted the name of the committee is shown in parenthesis:

- Committee: **II—Ballast;** ballast tools (Track).
- IV—Rail;** rail sections, rail drilling, bolts (Track).
- V—Track;** track tools, except ballast, tie plates (Ties, Ballast, Rail), Frogs, switches (Signals), switch stands, spikes, screw spikes, guard rails, rail braces (Signals), derails (Signals).
- VI—Buildings;** glass sizes, hydrants, fire (Water Service), hose, nozzles, etc., baggage trucks, hand, scales, freight house and baggage, fire extinguishers.
- VIII—Masonry;** Portland cement, cement testing, metal reinforcement.
- IX—Signs, Fences and Crossings;** highway crossing signs.
- X—Signals;** R. S. A. standards, switch lamps (Track), bridge lamps (Iron and Steel), highway crossing signs (Signs).
- XIII—Water Service;** wood tank details, tank fittings, water columns, tank gages, float valves.
- XVII—Wood Preservation;** No. 1 Creosote, No. 2 Creosote No. 3 Creosote, coal tar—creosote solution.
- XVIII—Electricity;** incandescent lamps (Signals), insulators, insulated wires and cables (Signals), tile and other conduits, friction, rubber and other tapes (Signals), knife and snap switches.

#### Discussion

Chairman Frink: Your committee has no conclusions to report this year, and the report is presented simply as information, but your attention is called to Appendix A, which presents a list of various items which the committee has suggested to the Committee on Outline of Work as fit subjects for standardization by the appropriate committee.

The Chairman: The report is before you for discussion.

J. L. Campbell (E. P. & S. W.): I think it would be a good deal of assistance to the Committee on Outline of Work, and possibly also to the Board of Direction, if we heard some discussion from the committee itself as to what the work of the committee on standardization should be, and how it should be done.

J. J. Yates (C. R. R. of N. J.): I have in mind the necessity of standardizing some articles. I have principally in mind one subject that is coming up, that has been up before our Association, that is, membership in the American Engineering Standards Committee. It is very important for this society to be represented in it. There are innumerable questions coming up that will interest the railroads, and at the present time we have some voice in that committee, but we have not as an association, and our Standardization committee suggested that this association become a member so as to have a voice in the standardization of articles that would be of interest to the railroads.

J. M. R. Fairbairn (C. P. R.): I think one of the most important things before the Association today is the question as to whether we are to continue as we have in the past to recommend practice, or whether we are to establish standards. Unless we do establish standards, I doubt if we will ever get the railroads of America to adopt our recommended practice to the same extent that they would if we establish standards. Further than that, I believe that we should keep ahead of the railroads. If we do not keep ahead then we will have to follow some one railroad and adopt what it has adopted or what manufacturers have made for them.

E. B. Katte (N. Y. C.): I, too, would speak in behalf of this Association taking membership in the American Engineers Standards Committee. That committee is now formed of only four or five of the national societies, and it is very desirable that the railroad interests and the railroad engineers should be represented.

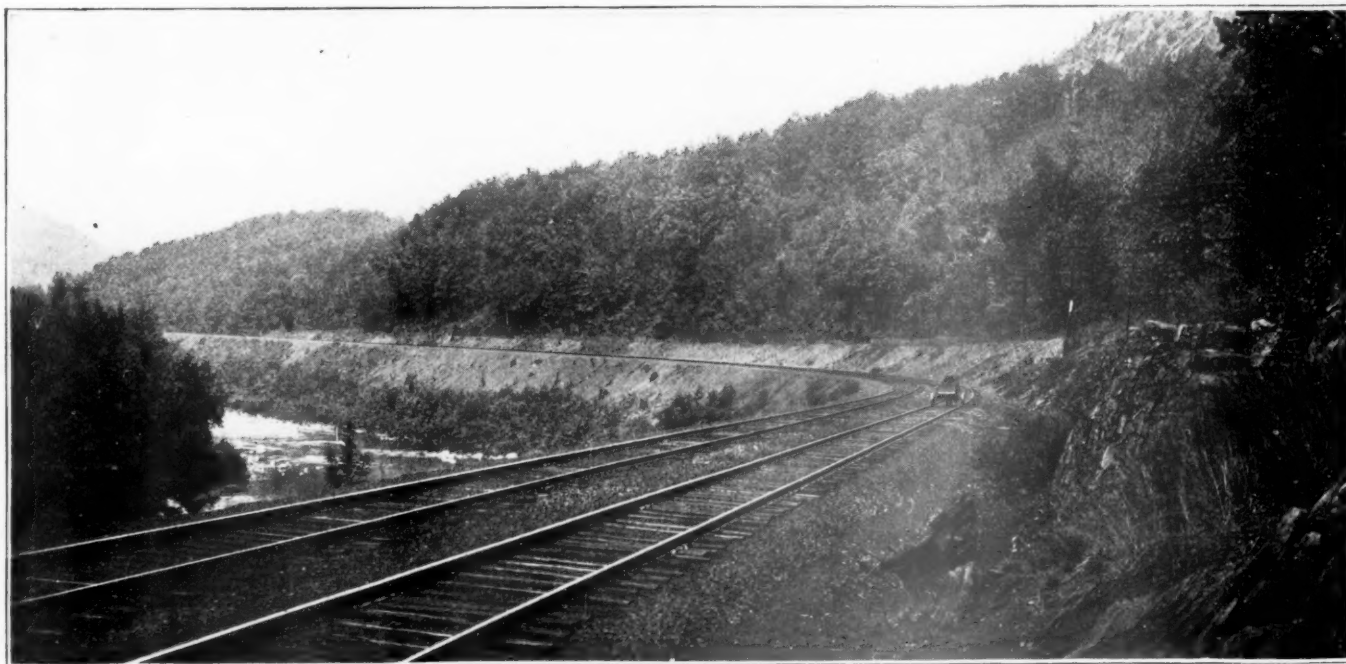
The matter was first brought to our board of direction a year ago, and met with some favor at that time, but we have not yet taken out a membership. A committee of three, I understand, will be appointed of the board to

look further into the matter, and I am quite sure that after they have familiarized themselves with the objects and aims of this National Standards Committee, that our Association will also be represented.

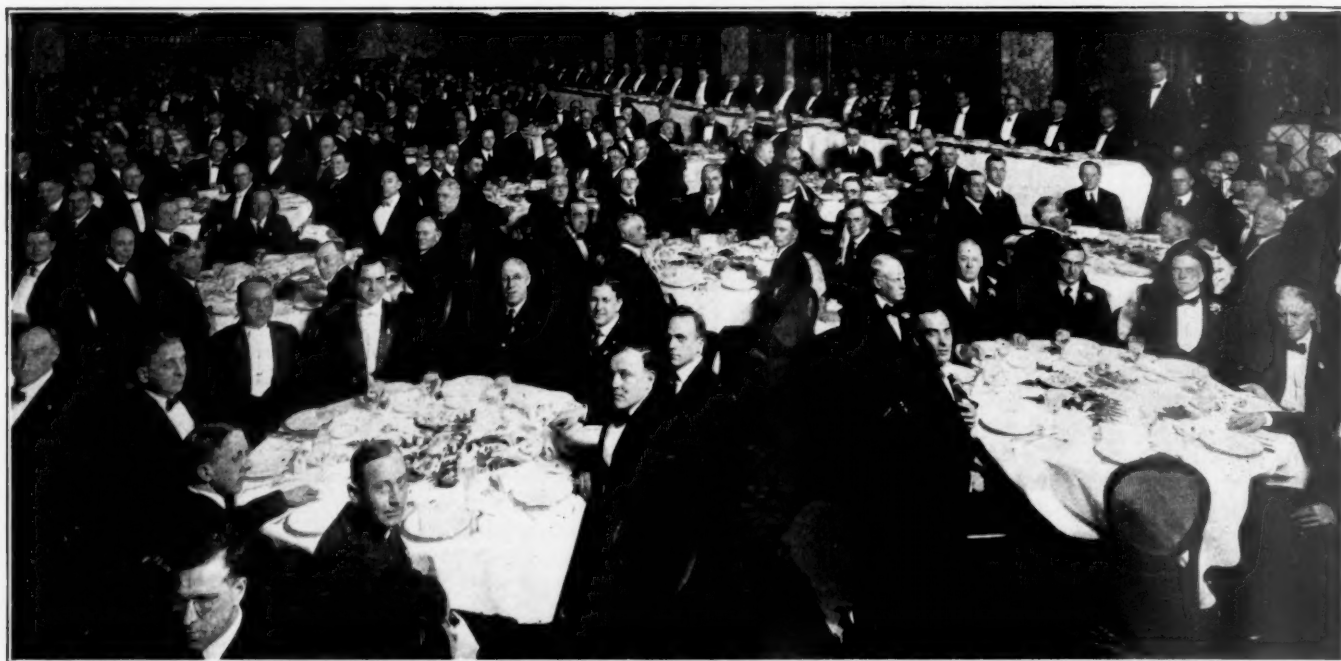
J. R. W. Ambrose (Tor. Term.): I am afraid I am that one. I do not agree with Mr. Katte at all. I think our Association is strong enough and able enough to stand upon its own feet. Surely at least we know as much or should know as much about railroad work as a standardization committee made up of various members from all branches of the technical world, and I think this Association should handle its own standards and look after its own standards. I now feel that the time has arrived when we should have standards, but it seems to me the fact that this Association prepares a standard does not mean it is to be used universally by the various roads, but if the Association could work in conjunction with the A. R. A., having the stamp of their approval on any standard we pass, it would seem then that it would be imperative that the standard be used, and we all know that the standardization of any article in railroad service spells economy and we also know that economy is the object we all want to attain.

Mr. Katte: Mr. Ambrose has done me the compliment to disagree with me, and perhaps I may be permitted to speak a little further. I think that the Committee on Standards, that is the American Committee on Standards, wants this Association to be with them, because this is the recognized authority on all railroad standards. I do not think that there would be any criticism of specifications of this Association for rails or track spikes, but there are other articles which we employ largely, yet which are employed to a greater extent by the members of other associations. I have, for instance, in mind the specification which we adopted yesterday on insulated wires and cables. The railroads of the country use a great many million dollars' worth of insulated wires and cables in a year, but that is only a very small part of the wires and cables used throughout the country. Now, if we can standardize on a number of cables the cost to the railroads and the other users will be materially reduced.

(The committee was excused with the thanks of the Association.)



A Bit of Picturesque Country Along the Boston & Albany



*At the American Railway Engineering Association Dinner Last Evening*

## The Dinner of the Engineering Association

Abstracts of the Addresses Presented at the Twenty-second Annual Banquet Held Last Evening

THE TWENTY-SECOND ANNUAL dinner of the American Railway Engineering Association was held in the Gold room of the Congress hotel last evening, President H. R. Safford presiding. After invocation by Dr. George L. Sherger, professor at Armour Institute of Technology, addresses were presented by Dr. David Kinley, president University of Illinois; the Honorable William Renwick Riddell, Justice of the Supreme Court of Ontario, and John Findley Wallace, chairman Chicago Railway Terminal Commission.

### The Association and the University

BY DR. DAVID KINLEY

President University of Illinois, Urbana, Ill.

I have been asked to say a few words about the common aims of the American Railway Engineering Association and the University, and possible points of contact and possible methods of co-operation between them. I gladly comply with such a request for several reasons. In the first place, even if I felt that the two organizations had nothing in common, I should still be appreciative of the request and thank you for the honor, sir, as did the old darky who was unable to change the ten dollar bill. Moreover, the very presentation of such a request indicates a thought in the minds of those who make it of possible lines of usefulness on the part of academic men which a few years ago would have been scouted at. Still further, this request marks this Association as an unusual organization. Few even of the so-called learned societies have been able thus far to look out from their own confines and realize the possibility of co-operative work to the common advantage.

It is clear that the Railway Engineering Association and the University of Illinois have common interests in several respects. They are both interested in the education of the employees and officers of the railways from whose

organization your membership is drawn, and they are both interested in the two fields of research which you, the established officers of these railways, find it necessary or desirable to pursue—the economic and the technical.

Turning first to the field of education common to both organizations, it is evident that the University and the Association are both deeply interested in the curriculum of the College of Engineering, in which we are trying to train the future employees and officers of railways. The friendly advice which such an association as this could give the University through the faculty of the College of Engineering in the organization of such a curriculum and in the maintenance of proper educational standards would be of great value to us. I know that we are all human and that advisory committees which begin by being advisory not infrequently end by becoming dominating. It is easy to pass from advising what to do to telling what to do. That is a difficulty which the University has experienced occasionally in the past. Nevertheless, in spite of that danger and possible friction that comes from it, we would welcome a closer advisory relationship between organizations like this and the University for the purpose of helping us to solve our educational problems. This point of contact relates to the education and training of future employees and officers.

There is another field of educational contact. Occasionally members of the University staff have been asked by the officers of railways to give series of lectures at different points on the roads to their employees. In short, we have been asked to establish an extension service to present employees, giving lectures and conducting classes not only on technical aspects of the work they do, but on general educational subjects for the development of their morale and their general betterment. This particular field of inquiry, the best method of conducting such work, its organization, the subjects to be presented,

and the educational institutions that might be used in doing it, are all proper subjects of inquiry for your Association in co-operation with the University of Illinois or any similar institution. I have sometimes thought that the efforts of great corporations to maintain educational work of this kind might be more successful if, under a committee of some such association as yours, certain universities or colleges were enlisted in co-operation and the work left to them under your general direction. A University-Railway Association Education Committee might accomplish a good deal both for the railways and for the University.

You may think that such work is not within the scope of your Association, but it certainly is as much so as any other means for improving the morale of your employees or supply of labor or labor turnover, subjects on which one of your committees has already made a report.

But the main field in which co-operation between your Association and the University of Illinois is most promising is the field of research. Your committees are constantly making investigations into technical subjects which are also under constant study by the University Engineering Experiment Station and members of the staff. Co-operation with the Engineering Experiment Station in technical and scientific research is, therefore, the matter that deserves our largest consideration. A mere reading of the list of technical topics on which your committees report, side by side with those that form the subjects of report from our Engineering Experiment

vantage of the general public. The University cannot, therefore, enter into any arrangement whereby any discovery made in its laboratories which is evidently a matter of great public advantage and whose exploitation by the general public is economically feasible can be put at the service of any particular individual or particular organization. On the other hand, occasionally the University is in a position to conduct an experiment exclusively for the benefit of an organization when it is clear that the results are not a matter of public concern, but rather a matter pertaining to the welfare of the particular organization.

One great difficulty with all university research departments is the lack of sufficient funds to conduct their experiments, especially on a scale large enough to justify conclusions on an industrial or commercial basis. Co-operative investigations, therefore, must be financed by the interests especially related to them and most likely to benefit from them. But within this general limitation I can see a very large, indeed, a practically unlimited field of co-operation between your Association and the University of Illinois.

From remarks that I have already made it is evident also that many things of an economic or business character could be studies in common between the University and your Association. For many years it has been my ambition to see at the University of Illinois a Bureau of Economic Research corresponding in a way to the Engineering and Agricultural Experiment Stations. My suc-



David Kinley



Hon. William Renwick Riddell



John F. Wallace

Station, is enough to show that we are both at work along the same general lines. Electrolysis and its effect on reinforced concrete, electrical interference, maintenance of track, fatigue of metals, causes of rail failure, effect of speeding on track maintenance, elements influencing the strength of concrete, are subjects that might as well describe investigations in the laboratories of the engineering experiment station as in the libraries and laboratories of your committees. Undoubtedly some topics could be more advantageously investigated by us than you, and the opposite is also undoubtedly true. This fact suggests the possibility of a common committee for conference and advice as to the better agency to which to allocate a proposed investigation and a consideration of the ways and means of carrying it out.

I may say that the University of Illinois has on several occasions undertaken co-operative investigations with industrial and other organizations. The University work in research is designed, of course, to discover any scientific and technical truths, methods, processes for the ad-

cessor at the head of the Department of Economics and also my successor as the director in the courses of Business Administration have the same ambition, and I trust that it will soon be realized. If it is, I see no reason why co-operative investigation in the methods of doing business, business organization, cost analyses, labor matters which are scientific and not partisan, and many other matters may not be studied co-operatively.

Still a third possible mode of co-operation is in my mind. Some years ago I urged on the then state government the passage of a law establishing at the Engineering Experiment Station a State Bureau of Standards similar, in a general way, to the Bureau of Standards at Washington. That would be an organization at which tests of all kinds for commercial purposes could be conducted on payment of proper fees, and might well be a place where some of the problems of your Association could be sent. It may be that the University is not the best place for such a bureau, but there should be such a bureau somewhere in the State administration.

Aside from all these things, there is, of course, the large field of general educational improvement in which your Association and the University are alike interested. While this might not give a basis for continuous co-operation, yet it seems to me that there are large questions of educational public policy which an association like this might well study and on which they might well express themselves. For example, the question whether or not electric tramways, railways, and mines shall be publicly owned or privately owned is not a question for engineers or miners or electricians or economists or any other class of society as such. It is primarily a great question of public policy on which any fair-minded citizen is entitled to express an opinion, whose value will depend upon his knowledge of the subject and our estimate of his judgment. However, when it has been decided which policy is to be adopted by a given community or country, all questions relating to securing efficiency of operation and service to the public under the policy decided on are questions for experts.

### Canada

BY HON. WILLIAM RENWICK RIDDELL  
Justice of the Supreme Court of Ontario

When we come to the United States we come not as strangers or as aliens, we come as one comes home. In all but the accident of political allegiance we are the same people. Aliens as we are by the strict and formal rules of international law, and standing apart by the evanescent and external form, by the great statutes of Heaven, in the essential and external, in all that is really worth while, Americans and Canadians are one.

What is it that so binds us in an indissoluble union? Race? Language? Religion? Oh, no. Race, language, religion, all are significant—immensely significant—but they are not everything—they are not even crucial.

The most potent and all-powerful force which binds us and unifies us is our common conception of human rights—individual rights—and the relative rights and the relative rights and duties of the State and the individual. We believe in democracy, real democracy, the rule of the people in whatever form.

In times of war we recognize the practical necessity for an autocracy more or less veiled—*inter arma silent leges*—but where such necessity does not exist we carry our love of liberty to great lengths. We follow Walt Whitman's advice, "Resist much, obey little." It is enough for us that a thing is "*verboten*" to make us wish to do it. The sign "keep off the grass" is taken as an implied invitation to trespass and the grass is promptly trodden down. Too often "we are content to believe that we cannot have both good government and liberty, and liberty we think the better of the two." This liberty necessarily means the right to govern ourselves, and that it is tyrannous for another to govern us—a concept unknown to the undeveloped or ill-developed races in some parts of the earth who claim the right to be governed, so that it is almost tyrannous to compel them to govern themselves. Such are they who could hear the head of their state boast, "There is but one will in this land and that is mine—him who opposes me I will crush," without rebelling or a universal outburst of derisive and inextinguishable laughter.

Self-government is democracy, whether the form be monarchical, republican or what you will. The vesture is naught, the soul is what counts, and here are seldom "the letter killeth but the spirit giveth life." What is called a republic may be a mere oligarchical tyranny. What are some of the so-called republics, even in modern times, of South and Central America?

Democracy is not a form, it is a vital principle man-

ifesting itself in many ways, under as divers shapes as life itself.

I am not one of those who believe, or pretend to believe, that democracy was born on the Fourth of July, 1776, and that her birthplace was upon this continent. I do not believe, nor do you believe, that liberty was unknown and non-existent before the Declaration of Independence.

The ultimate source lies far removed from the trodden path of civilization, not in Rome, not in Greece, still less in Babylon or Persia, but in the bleak, cold fens and the dense forests of northwestern Europe, where Angle and Saxon and Jute maintained their proud independence, and alone of all the nations refused to bend the knee to the Imperial Mistress of the world.

The English Bill of Rights in 1689 laid down principles of democracy in systematic form, and democracy was well advanced before George Washington was born.

The Revolution which sundered the British Empire was no cataclysm—it was not like the atheist and terrorist revolution in France which Goldwin Smith did not hesitate to call the "greatest of all calamities in history"—a complete breaking up of the foundations of society, of law, of government. There was nothing in the Revolution or in the conduct of it—though revolutions are neither made nor quelled with rose-water—which necessitated ill-feeling, once the new State had been established. Nor until driven by bitter necessity did the Fathers of the Revolution determine that America should sever her connection with the Empire.

It is a wicked libel to say that even before or during the Revolutionary war, England or the English were opposed to the aspirations of the American people. The best part of the public men of England or the English people were in favor, but their voice was overruled by the gross ignorance and foolish arrogance of the king and his chosen advisers.

The mass of the English people were always and are now not only friendly to the United States—they are proud of the United States. You may find here and there a relic of the dislike which the patrician class felt for republicanism. Prejudice dies hard, and the fool ye have always with you. I have seen as great, as unreasoning detestation of England and of modern Englishmen in Maine as I ever saw or heard of in England against Americans.

That Canada and the rest of the British Empire today are free is due largely to the example of American democracy in 1776. The embattled farmers who stood and fired the shot heard round the world, fought not only for themselves and the rest of those of the thirteen colonies and the great states that were to proceed from the thirteen colonies, not only for their descendants for generation after generation in these United States, but for Canada, too, for Australia and New Zealand, and South Africa, aye, for England herself, and all that makes the British Empire worth while.

With all these ties I do not fear that you need to im-bibe a more favorable knowledge of the Canadians and their character.

But I am not so sure that the nature and character of our government do not need to be more fully appreciated.

Not many weeks ago in this city, a man of eminence from New York was eloquently demanding that England should set Canada free—throwing in Australia for good measure. Not three weeks ago in this city, a person calling himself a Canadian was declaiming against the king and his pretensions over Canada. A well-known American author in a recently published book asks if England will, in the future, continue to rule Canada. Thousands of Americans insist that Canada must vote in the League

of Nations as Britain may wish, or British interests may indicate. I have myself been asked why does Canada not shake off the English yoke and elect a President for herself. These and a hundred other like facts indicate that there is a widespread misunderstanding of Canada's true position.

The "back number" who lives in the past has some ground for his ideas of Canada if he reads and thinks of the past only, for England did once rule Canada—as she once ruled America.

Let us speak of the present—for the Great War has forced a growth in the Constitution of Canada—greater than decades did previously. Before the awful Cataclysm, Canada had achieved with England's glad and proud consent, full control over her own territory, her own tariff, her own trade, her own people. Nay, she took part in Imperial Conferences in advising the general course of the Empire, and even succeeded in causing the denunciation of Imperial Treaties which stood in her way. She had negotiated treaties and formed an International Commission with the United States. She had repudiated the title "Colony."

Then came the War, *the War*, before which all other wars from the beginning of time pale their ineffectual fires.

When Germany made the assault on innocent Belgium, so long preparing, and at last thought certain of success, Canada did not delay a moment. The Atlantic cable carried the message: "The last man and the last dollar."

From the earliest days of Canada there has never been a stricken field where British troops fought but a Canadian was present—Waterloo, the charge of the Light Brigade at Balaclava, Kars, where the Canadian Williams held the foe at bay for months; these and many other fields of battle saw the Canadian fighting for his flag. But all these were volunteers, and while they were Canadians they were equipped and paid by Britain.

Now there was a change, Canada raised her own forces, equipped them, paid them, cared for them, and pays the pensions of the survivors, and widow and child of the honored dead. Sixty thousand Canadian dead and three times as many wounded prove how Canada acquitted herself. England could not call upon us for a soldier, a ship, an ounce of supplies, a cent of money; nor did we fight for England. We poured out our money like water, our men died in tens of thousands for a struggle which we call our own because we believed and believe it to be for humanity at large, and our chosen form of civilization.

May I venture the assertion that Canadians generally recognized that the war was the great Armageddon, the final and most terrible struggle for freedom the world has ever seen; and that the war was the crucial test of Democracy, sooner and more clearly than any other people, and Canada fought for herself, her own fight and not another's.

Her boys were dying in thousands, her mothers weeping the dead, her homes were desolate, and she thought that she should have some say in how the War should be carried on. Britain recognized that old things had passed away, and that the time had come frankly to acknowledge that Canada and the other Dominions had ceased to be in any sense dependent, but had become sister nations standing on an equality with her. The common effort and sacrifice in the war inevitably led to a recognition of an equality of status between the responsible governments of the Empire.

Accordingly in 1917, the prime minister of Great Britain called together the prime ministers of the self-governing Dominions for consultation on vital matters of policy relating to the prosecution of the war. They met as equals, as prime ministers of the nations of the Empire,

to discuss matters of common concern to the whole Empire.

The old forms remain like the old titles of the king—the spirit is new, the reality is transcendent.

In our British system, we build more stately mansions on the old foundations, we graft new and living buds on the old stock, without an outward change we renew, we quicken, we transform the spirit.

Some day, perhaps in a few months, there will be a conference of the statesmen of the Empire to frame a written constitution in some degree tying the theory to the reality, the letter to the spirit. Whatever be the result, we Canadians will remain steadfast; we cannot and will not give up our share of the old flag, or sever ourselves from the rest of the British world, but we will not revert to the status of a colony.

We are a free and self-governed people, an adjunct of no nation on earth, either on this side of the Atlantic or the other.

It is on these terms, and on no other or different, that we offer our friendship. We value beyond rubies the friendship of the United States, we offer our own, we yearn for yours. We will not beg for it—Canada can stand four square to the winds of Heaven, rely upon herself, her own industrial ability and resources, if she must, but she hungers for real brotherhood with the people of the United States.

Are we—have we shown ourselves to be—such as you desire for friends? Have our efforts and our sacrifices during the war shown us to be such as you would take up with? That is for the United States to answer.

A little broader is the real question upon which the future of the world depends. Are the English speaking peoples to stand together? If the answer be "Yes" civilization is safe, if "No," woe unutterable—one League of Nations must exist or all is lost. Let but the English speaking peoples be one in purpose and in determination and the future is secure.

When last I spoke to an American audience I ventured to say, and I repeat it here, "The world is to be made better, brighter, happier. It must be the task of the English speaking race to bring that about."

France, gallant, heroic France, must for generations watch the Rhine; two assaults she has experienced, a third might be fatal. Italy, worthy child of old Rome, relieved, indeed, of the spectre of evil omen scowling over the Alps, is cribbed, cabined, and confined by the necessity to overcome at home the effect of impoverishment of ages past. Germany, if she would, could not for generations do more than repair her shattered industrial and commercial life—and who would trust her in any case?

May the United States increase in wealth and prosper in every way—the more she does the more will the rest of the English speaking world rejoice.

### Reminiscences of John F. Wallace

It is very gratifying to me to appear before you tonight and particularly so at a time when the outgoing president and the incoming president are Bob Safford and Larry Downs, two of your presidents who commenced their career under my administration as chief engineer of the Illinois Central.

It was suggested by President Safford and some of the other members of the Association that the younger members, particularly, would like to hear something of the causes which led to the organization of the Association and the forming of its constitution, with its peculiar organization and peculiar outline of work and how this association came into existence.

In about 1898 there was a maintenance of way association in this country which was called the Roadmasters' Association. In that day the roadmaster had charge of about 100 or 120 miles of track, and held a position that on the larger systems today is called a supervisor. These men were practical men, mainly.

At the Denver convention of the Roadmasters' Association in 1898 there was a small group of men known as engineers of maintenance of way who desired to associate themselves with the Roadmasters' Association and learn what they could from these practical railroad roadmasters. They were treated with more or less of a cold shoulder and this small group of the technical engineers and engineers of maintenance of way came back from that meeting and felt that the time had come when, if that association could not be broadened and controlled and developed by the technical men who were gradually working into positions in charge of maintenance of structures, that it was time to form an association on a higher, larger, broader plane.

They took the matter up with some of their superiors, and later on, I think it was the latter part of 1898, a small group of men met in Chicago among whom was Mr. Torrey, the chief engineer of the Michigan Central, Mr. L. C. Fritch, who sits on my left, Mr. Curtis Dougherty, then engineer of maintenance of way of the Illinois Central, and a few other engineers. They formed a temporary organization of which Mr. Torrey was chairman and Mr. Fritch secretary. At that time they wanted to get the sanction of some of the larger roads which were building at that time or had built up scientific maintenance of way organizations under engineering supervision.

They appointed a committee consisting of myself as chairman, Thomas Rodd of the Pennsylvania, Walter Katte, chief engineer of the New York Central, Mr. Curtis of the Southern Pacific and Mr. Peterson, chief engineer of the Canadian Pacific. When that committee was appointed I was unaware of it, but a few days afterward, Mr. Torrey, whom I presume a few of the old members of this association knew, came into my office and told me about this organization work, and asked me to accept the chairmanship on permanent organization.

One of the members of the committee was in San Francisco, another in New York, another in Montreal and another in Pittsburgh, and all of us were busy men. We corresponded, and then we sent out a circular letter and got all sorts of replies. One man wanted to confine the association to chief engineers; another wanted to confine it to engineers of maintenance of way, etc. Finally it occurred to two of us—I will not mention any names on account of the memories of some of you gentlemen here—that we had to have something different from any other organization that was formed if we expected to do successful work. We felt that the ordinary scientific papers which were prepared without any direction or without any correlation of the different members was a waste of effort. We finally made up our minds that we must block out a line of investigation of work that would mean something.

Out of that idea grew this plan of forming constant standing committees that would cover every branch of railway engineering work, even to administration. I think we even included accounts at that time.

Then our next idea was to get the members to work. Then we made up our minds that we would have a series of standing committees, and we assigned every member of the organization to a place on a committee; that we would have these committees make annual reports; that we would have each member, on account of the wide membership of the railroads, have credentials that would enable the chairman to get information along the line of

the work of that committee from every railroad in the land.

The main object and purpose of this committee work was to eliminate peculiarities. One of the first things that occurred to us was our rails. Every railroad in this country had its own peculiar standard and section of rail. We thought if we could get a standard rail we might induce the rolling mills to keep rails in stock so that we could get them as we wanted them. We have not accomplished that yet.

Then we found a great many different ideas among the railway engineers all over the country, and in every case we hardly approached a fixed standard, for as you gentlemen know who were in the Association 22 years ago there was hardly a committee that did not find that every chief engineer had his own ideas, his own standard frogs, his own standard switch stands and all that sort of thing.

After we drew up the constitution as it originally was outlined, the original skeleton, we sent it around to the other members of the committee and told them that this was what seemed to be in the minds of the majority of the committee, and asked them to sign it, which they all did.

A meeting to form the permanent organization was arranged at Buffalo and I got a telegram from Mr. Torrey, who said: "The report of your committee has created a great deal of criticism among a great many members. You had better come on to Buffalo and present it in person to the permanent organization meeting." We had a meeting at a hotel there and after I read the constitution and commented on it Mr. Torrey put it to a vote and it was adopted unanimously, to my great surprise. Later on I was notified that they had elected me president.

### Roadway Committee Meeting

There will be a meeting of the Roadway Committee in Room 1102 of the Congress Hotel at 9 o'clock this morning.

### Invitation to Visit Underwriters' Laboratories

G. B. Muldaur, general agent of the Underwriters' Laboratories, 207 E. Ohio street, Chicago, extends an invitation to the members and other railway men attending the convention to visit the laboratories and observe the work under way in that institution. These laboratories are a non-commercial institution organized to test construction materials to promote safety from fire and accident. Tests are continually in progress on various building materials to determine their relative resistances to hazards of this character.

### Western Society of Engineers

The Western Society of Engineers, Railroad Section, will hold a meeting in the offices of the society on the 17th floor of the Monadnock block, at 7 o'clock, Thursday, March 17, at which C. F. Loweth, chief engineer of the Chicago, Milwaukee & St. Paul will present a paper on "The Classification and Maintenance of Old Railroad Bridges." A moving picture film showing the laying of rail on the Lehigh Valley by the use of locomotive cranes and the application of other labor saving equipment to auxiliary operations will also be shown. All members of the American Railway Engineering Association and other railway officers are cordially invited to attend this meeting and to participate in the discussion.

# The A. R. E. A. Elects New Officers

Results of Annual Election Announced Yesterday; Sketch  
of President-Elect L. A. Downs

**S**HORTLY BEFORE THE CLOSE of the afternoon session yesterday, Secretary Fritch announced the results of the balloting for officers for the ensuing year. The election resulted as follows:

President, L. A. Downs, vice-president and general manager, Central of Georgia, Savannah, Ga.

Vice-President, E. H. Lee, vice-president and general manager, Chicago & Western Indiana, Chicago.

Treasurer, G. H. Bremner, district engineer, Bureau of Valuation, Interstate Commerce Commission, Chicago.

Secretary, E. H. Fritch, Chicago.

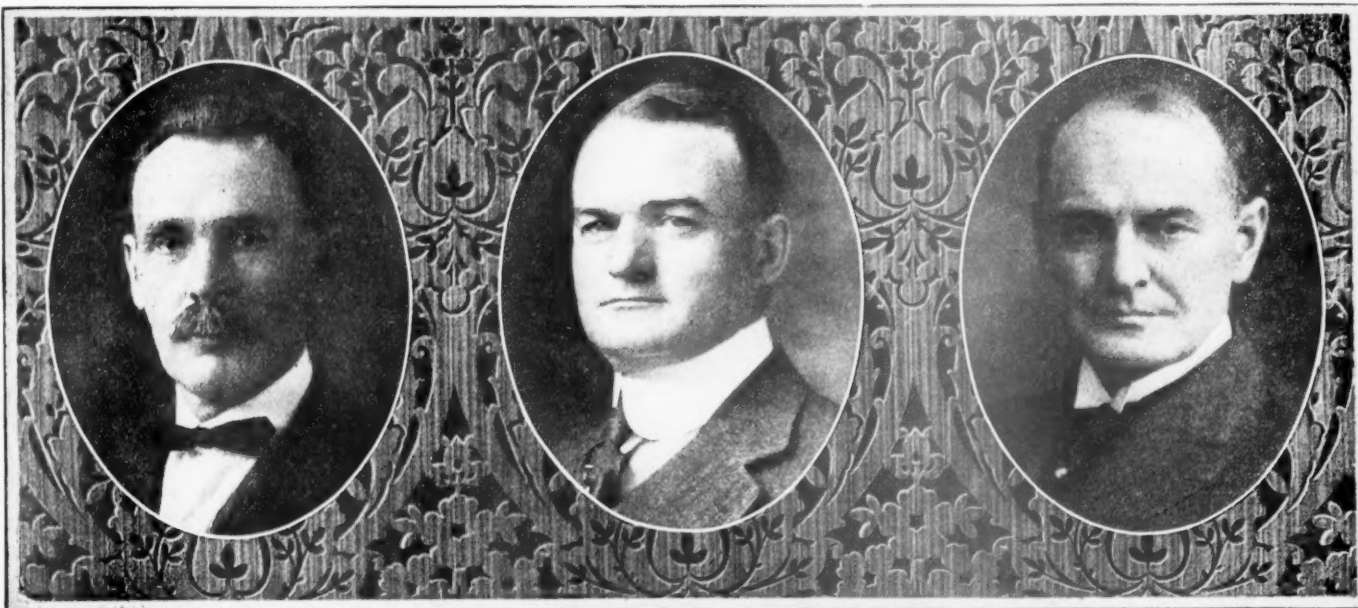
Directors: C. F. W. Felt, chief engineer, Atchison, Topeka & Santa Fe, Chicago; G. J. Ray, chief engineer, Delaware, Lackawanna & Western, Hoboken, N. J., and Colonel G. H. Webb, chief engineer, Michigan Central, Detroit, Mich.

Nominating Committee: J. R. W. Ambrose, chief engineer, Toronto Terminals, Toronto, Ont.; R. H. Ford, assistant chief engineer, Chicago, Rock Island & Pacific,

road which employs him. The case of Lawrence A. Downs is no exception to this rule. For many years he has had an active part in the affairs of the Association and as vice-president and general manager of the Central of Georgia, he occupies a position which permits of no question as to his ability as a railway officer.

In the affairs of the Association Mr. Downs has been identified primarily with the Committee on Ties because of his personal interest in this subject. He was an active member of this committee for many years and served for five years as its chairman. As a member of the Board of Direction he was the prime mover in the campaign for increased membership carried on during the last year, as a result of which 500 new members were added to the Association. Owing to the fact that it was deemed inadvisable to enlist the entire membership of the Association in this campaign, the results secured are largely the consequence of the personal work done by Mr. Downs.

In two respects the career of the new president and



J. L. Campbell  
First Vice-President

L. A. Downs  
President

E. H. Lee  
Second Vice-President

Chicago; E. A. Hadley, chief engineer, Missouri Pacific, St. Louis; J. V. Neubert, engineer of track, New York Central, New York City, and A. F. Robinson, bridge engineer, Atchison, Topeka & Santa Fe, Chicago.

## Lawrence A. Downs, President of the American Railway Engineering Association

The presidents of the American Railway Engineering Association are selected through the agency of a nominating committee subject to the popular approval of the Association. Whatever the opinion of this indirect method of selection, it must be conceded that the results secured under this system have been excellent. A study of the nominations from year to year will indicate that the committee has been governed by two prime considerations: the value of the man to the Association as demonstrated by a whole-hearted interest and service in its behalf and evidence of intrinsic worth as shown by the confidence bestowed upon the candidate by the rail-

that of his predecessor bear a marked resemblance. Both are graduates of Purdue—Downs in the class of 1894 and Safford in the class of 1895. Both gained a large part of their railway experience on the Illinois Central. For a time they were roadmasters together. Whether this comparison may be carried any further without encountering sharp contrast in personal makeup, the friends of both decline to be placed on record. It suffices to say that the outgoing president has established a mark which bids fair to be continued throughout the term of his successor.

The new president is a strong man, yet one who is particularly endowed with truly human characteristics which have served to endear him in the hearts of his associates and those who have been so fortunate as to have been employed under his direction. The magnetism of his personality is by no means restricted to the close contact that comes with friendship or professional relations, but has manifested itself in his appearance before the Association convention. With a certain straightforwardness, frank-

ness and air of confidence in his bearing, he is quick to win the confidence and sympathy of his auditors. He has also had the happy faculty of being able to punctuate his remarks with a humor that has served to drive home his arguments. Those who attended the convention in 1916 will recall his well chosen comments on the futility of forestry as a railway undertaking.

As a man who has graduated from an engineering or maintenance of way position to that of an executive officer, his career is of particular interest to those whose ambition leads them in the same direction. He is a product of the maintenance of way department of the Illinois Central which has produced more than its share of leading railway officers and not a few presidents and directors of the A. R. E. A. Following his graduation from Purdue University, he entered the employ of the Vandalia, but joined the Illinois Central organization in 1896 and continued constantly in the employ of that property until March 1, 1920, when he was elected vice-president of the Central of Georgia, a subsidiary. His experience with the Illinois Central included service in engineering parties, nine years as a roadmaster and a period as assistant chief engineer of maintenance, until December, 1910, when he entered the operating department as a division superintendent. Subsequently, he was advanced to general superintendent and in January, 1919, to assistant general manager. Mr. Downs' election as president of the American Railway Engineering Association will accrue to the advantage of that society and be a source of inspiration to its members.

### A. R. E. A. Registration

THE REGISTRATION OF MEMBERS and guests of the American Railway Engineering Association yesterday aggregated 172, making a total registration for the two days of 765, as compared with 718 at the same period last year. Of the total registration this year 619 were members.

Abbott, W. P., Asst. Engr., B. & O., Cincinnati, Ohio.  
 Adams, L. L., Roadmaster, L. & N., Etowah, Tenn.  
 Anderson, Anton, Engr. M. W., C. I. & L., Lafayette, Ind.  
 Andrews, J. T., Asst. Engr., B. & O., Baltimore, Md.  
 Baird, R. C., Asst. Engr., C. R. I. & P., Chicago.  
 Baldwin, Springfield, Ch. Engr., G. & F., Augusta, Ga.  
 Barnhart, E. H., Asst. Engr., B. & O., Baltimore, Md.  
 Baxter, J. J., Div. Engr., Wabash, Peru, Ind.  
 Beckett, F. T., Engr. M. of W., C. R. I. & P., El Reno, Okla.  
 Belcher, R. S., Mgr. Treating Plants, A. T. & S. F., Topeka, Kan.  
 Bloecher, Theodore, Jr., Div. Engr., B. & O., Baltimore, Md.  
 Bradley, A. C., Div. Engr., C. R. I. & P., Colorado Springs, Colo.  
 Bratager, S. J., Prin. Asst. Engr., N. P., St. Paul, Minn.  
 Briggs, Z. M., Asst. Engr., Pennsylvania, Pittsburgh, Pa.  
 Brooke, G. D., Supt. Trans., B. & O. Western Lines, Cincinnati, Ohio.  
 Brooke, Richard, Div. Engr., B. & O., Weston, W. Va.  
 Brown, H. W., Div. Engr., Pennsylvania, Zanesville, Ohio.  
 Browne, H. L., Asst. Engr., C. B. & Q., St. Louis, Mo.  
 Burke, M. J., Asst. Engr., C. M. & St. P., Seattle, Wash.  
 Burrage, W. H., Pilot, Val. Dept., N. Y. C. & St. L., East Cleveland, Ohio.  
 Butterworth, A. S., Ch. Engr., G. F. & A., Pensacola, Fla.  
 Campbell, H. A., Chicago.  
 Cleveland, G. C., Ch. Engr., N. Y. C., West of Buffalo, Cleveland, Ohio.  
 Correll, E. J., Div. Engr., B. & O., New Castle, Pa.  
 Crable, Arthur, Engr. M. W., Hocking Valley, Columbus, Ohio.  
 Crites, G. S., Div. Engr., M. W., B. & O., Baltimore, Md.  
 Crowell, F. N., Div. Engr., Pennsylvania, Cincinnati, Ohio.  
 Crumpton, Arthur, Val. Engr., Grand Trunk, Montreal Canada.  
 Dansey, J. W., Asst. Engr., A. T. & S. F., Chicago.  
 Delo, C. G., Chief Engr., C. G. W., Chicago.  
 Dewees, A. R., Div. Engr., P. M., Saginaw, Mich.  
 Doyle, T. L., Div. Engr., Penna. Lines, Grand Rapids, Mich.  
 Edwards, W. R., Sen. St. Engr., I. C. C., Washington, D. C.  
 Ehrke, John, Asst. Supt., G. T., Battle Creek, Mich.  
 Eiker, W. H., Dist. Engr., C. B. & Q., Lincoln, Neb.  
 Elliott, L. B., Engr. M. W., Big Four, Indianapolis, Ind.

Everham, A. C., West. Con. Man., Raymond Concrete Pile Co., Chicago.  
 Flora, G., Val. Dept., G. T., Durand, Mich.  
 Ford, R. H., Asst. Ch. Engr., C. R. I. & P., Chicago.  
 Freeman, J. E., Mgr. Street Bureau, Portland Cement Association, Chicago.  
 Freygang, A. H., Div. Engr., B. & O., Grafton, W. Va.  
 Frick, O. H., Dist. Engr., C. M. & St. P., Chicago.  
 Fritch, L. C. (Past-President), Vice-President in Charge of Construction, Maintenance and Capital Expenditures, C. R. I. & P., and Minneapolis & St. Louis, Chicago.  
 Fulks, E. B., Pres., Arkansas Preservation Co., 913 Carleton Bldg., St. Louis, Mo.  
 Gaines, R. H., E. M. Way, T. & P., Dallas, Tex.  
 Gaut, J. B., Supt. B. and O., G. T., Chicago.  
 Giles, W. H., Asst. Engr., M. P., St. Louis, Mo.  
 Gowdy, R. C., Ch. Engr. for Corp., C. & S., Denver, Colo.  
 Graves, W. F., Ch. Engr., Montreal Tramway Co., Montreal, Can.  
 Griggs, A. B., Val. Engr., A. T. & S. F., Eastern Lines, Topeka, Kan.  
 Griswold, H. C., Louisville, Ky.  
 Hallsted, R. H., Div. Engr., Mo. Pac., Wynne, Ark.  
 Hamilton, H. F., Res. Engr., G. N., St. Paul, Minn.  
 Hammond, E. W., Engr. M. W., B. R. & P., Rochester, N. Y.  
 Hanna, J. V., Ch. Engr., K. C. T., Kansas City, Mo.  
 Hansen, H. J., Office Engr., C. M. & St. P., Chicago.  
 Harman, H. H., Engr. Bridges, B. & L. E., Greenville, Pa.  
 Harsh, H. H., Div. Engr., B. & O., Pittsburgh, Pa.  
 Hartley, L. C., Chief Engr., Chicago & Eastern Illinois, Chicago.  
 Harvey, A. E., Ch. Engr., Metr. St. Ry. Co., Kansas City, Mo.  
 Hatch, H. A., Div. Engr., A. T. & S. F., Chanute, Kan.  
 Hawthorne, F. M., Div. Engr., Pennsylvania, Logansport, Ind.  
 Hayward, G. I., Asst. Dist. Engr., N. P., St. Paul, Minn.  
 Heidenthal, W. C., Engr. M. W., N. Y. O. & W., Middletown, N. Y.  
 Heritage, C. S., Bridge Engr., K. C. S., Kansas City, Mo.  
 Herth, C. E., Div. Engr., B. & O., Seymour, Ind.  
 Hewes, John, Jr., Div. Engr., B. & O., Flora, Ill.  
 Hillman, A. B., Asst. Engr., Belt, Chicago.  
 Hood, J. M., Supt., A. C. & Y., Akron, Ohio.  
 Hopkins, A. T., Asst. Val. Engr., M. C., Detroit, Mich.  
 Johnson, J. E., Saginaw, Mich.  
 Johnson, J. M., Con. Engr., I. C., Louisville, Ky.  
 Johnson, Noah, Val. Engr., Wabash, St. Louis, Mo.  
 Johnston, C. E., Gen. Man., K. C. S., Kansas City, Mo.  
 Johnston, D. B., Div. Engr., Pennsylvania, Louisville, Ky.  
 Jonah, F. G., Ch. Engr., St. L. S. F., St. Louis, Mo.  
 Kissell, J. E., Engr. M. of W., Big Four, Mt. Carmel, Ill.  
 Kulp, B. R., Div. Engr., C. & N. W., Madison, Wis.  
 Lane, E. G., Engr. M. W., B. & O., Eastern Lines, Baltimore, Md.  
 Lang, P. G., Jr., Asst. Engr. of Bridges, B. & O., Baltimore, Md.  
 Larsen, Albert, Div. Engr., Miami Con. Dist., Dayton, Ohio.  
 Lawton, L. C., Div. Engr., A. T. & S. F., Newton, Kan.  
 Layng, F. R., Engr. Track, B. & L. E., Greenville, Pa.  
 Leeds, R. M., Roadmaster, L. & N., Louisville, Ky.  
 Longwill, M. F., Div. Engr., Wabash, Montpelier, Ohio.  
 Mack, W. C., Draftsman, C. R. I. & P., Chicago.  
 Maenner, L. T., Office Engr., M. P., St. Louis, Mo.  
 Mann, B. H., Sig. Engr., M. P., St. Louis, Mo.  
 McFetridge, W. S., Prin. Asst. Engr., B. & L. E., Greenville, Pa.  
 Miller, R. E., Engr. Br., St. L. S. F., St. Louis, Mo.  
 Mullen, Joseph, Gen. Mgr., Southern Acid & Sulphur Co., St. Louis, Mo.  
 Newhouse, C. E., Asst. Div. Engr., B. & O. S. W., Seymour, Ind.  
 O'Rourke, G. M., Roadmaster, I. C., Mattoon, Ill.  
 Petersen, W. H., Engr. M. W., C. R. I. & P., Des Moines, Ia.  
 Petri, Philip, Div. Engr., B. & O., Cumberland, Md.  
 Pfafflin, E. H., Ch. Engr., C. T. H. & S. E., Chicago.  
 Pfeifer, H. J., Ch. Engr., Term. R. R. Assn., St. Louis, Mo.  
 Phillips, H. C., Ch. West. Group Engr. Com., I. C. Val.  
 Pifer, C. W., U. S. R. A., Chicago.  
 Purdon, C. D., Consulting Engineer, St. L. S. W., St. Louis, Mo.  
 Radspinner, W. A., Spec. Engr., B. & O., Western Lines, Cincinnati, Ohio.  
 Ray, W. M., Asst. Engr., B. & O., Pittsburgh, Pa.  
 Raymond, W. G., Dean, Col. Appl. Sc., State Univ. Iowa, Iowa City, Ia.  
 Reagan, J. H., Supt. Track, G. T., Detroit, Mich.  
 Riegler, L. J., Asst. Engr., Pennsylvania, Pittsburgh, Pa.  
 Ringer, Frank, Ch. Engr., M. K. & T., St. Louis, Mo.  
 Rist, C. J., Div. Engr., P. M., Saginaw, Mich.  
 Roach, J. H., Val. Engr., N. Y. C., New York City.  
 Robbins, O. B., Senior Str. Engr., Bureau of Val., I. C. C., Chicago.  
 Rockefeller, R. P., Office Engr., C. M. & St. P., Chicago.  
 Rodenbaugh, H. N., Ch. Engr., F. E. C., St. Augustine, Fla.  
 Sawyer, Mott, Asst. Gen. Supt., C. M. & St. P., Minneapolis, Minn.

Scott, H. E., Asst. Engr., Wabash, Moberly, Mo.  
 Simmons, I. L., Bridge Engr., C. R. I. & P., Chicago.  
 Sisson, F. P., Div. Engr., G. T. W. L., Detroit, Mich.  
 Smith, H. R., Engr. Acct., P. M., Detroit, Mich.  
 Smith, R. M., Asst. Engr., M. P., Falls City, Neb.  
 Snyder, J. A., Roadmaster, M. C., Jackson, Mich.  
 Speiden, Theodore, Jr., Div. Engr., B. & O., Philadelphia, Pa.  
 Spencer, C. H., Dist. Engr., Bureau Val., I. C. C., Washington, D. C.  
 Sprague, Willson, Div. Engr., N. Y. C. & St. L., Conneaut, O.  
 Stevens, Thos. S., Signal Engr., Santa Fe System, Topeka, Kan.  
 Stimson, F. J., Ch. E. M., S. W. Region, Pennsylvania, St. Louis, Mo.  
 Stuggs, R. M., Engr. Bridges, M. K. & T., St. Louis, Mo.  
 Sturdevant, C. F., Div. Engr., C. B. & Q., Lincoln, Neb.  
 Teal, J. E., Asst. Engr., B. & O., Baltimore, Md.  
 Vent, F. G., Asst. Engr., I. C., Chicago.  
 Wait, B. A., Div. Engr., C. R. I. & P., Cedar Rapids, Ia.  
 Washburn, R. H., Asst. Engr., M. & C., C. & A., Springfield, Ill.  
 Weatherly, E. P., Contracting Engineer, Kansas City, Mo.  
 White, H. H., Asst. Engr., M. P., Little Rock, Ark.  
 Whiting, C. L., Supt. Term., C. M. & St. P., Milwaukee, Wis.  
 Williams, C. C., Prof. C. E., University of Kansas, Lawrence, Kan.  
 Williams, H. W., Spec. Rep. to Supt. M. P., C. M. & St. P., Chicago.  
 Williams, W. D., Engr. M. Way, C. C. C. & St. L., Van Wert, Ohio.  
 Woerner, A. H., Div. Engr., B. & O., Wheeling, W. Va.  
 Wonson, S. L., Bridge Engr., M. P., St. Louis, Mo.  
 Woodbury, W. H., Val. Engr., D. & I. R. and D. M. & N., Duluth, Minn.  
 Young, R. C., Ch. Engr., L. S. & I. and Munising Rys., Marquette, Mich.  
 Ziegweid, A. B., Sen. Civ. Engr., I. C. C. Valuation, Hinsdale, Ill.  
 Zook, M. A., Res. Engr., Bureau of Val., I. C. C., Washington, D. C.

#### Guests

Barrett, P. T., Office Engr., C. & W. I., Chicago.  
 Beahan, R. J., Chief Engr., C. L. S. & S. B., Michigan City, Ind.  
 Bochtelheimer, A. E., Gen. Bridge Insp., C. & N. W., Chicago.  
 Bloom, J. G., Div. Supt., C. R. I. & P., Eldorado, Ark.  
 Bennett, W. R., Track Supvr., Wabash, Montpelier, Ohio.  
 Buchanan, E. G., Roadmaster, A. T. & S. F., Independence, Kan.  
 Chipman, Paul, Val. Engr., P. M., Detroit, Mich.  
 Cummings, A. E., Raymond Concrete Pile Co., Chicago.  
 Davis, H. E., Grasselli Chemical Co., Cleveland, Ohio.

Davis, M. B., Asst. Engr., I. C., Chicago.  
 Fulweiler, W. H., Const. Chem., United Gas Improvement Co., Philadelphia, Pa.  
 Gainer, A. T., Designing Engr., L. & N., Nashville, Tenn.  
 Graves, F. H. C., Asst. Supv. Track, B. & A., Springfield, Mass.  
 Gibson, H. R., Div. Engr., B. & O., Clifton Forge, Va.  
 Hammer, J. B., Arch. Draftsman, G. T., Detroit, Mich.  
 Hayward, G. I., Asst. Dist. Engr., N. P., St. Paul, Minn.  
 Hawkinson, W. M., G. T., Detroit, Mich.  
 Hutchinson, J. B., Pennsylvania, Chicago.  
 Haywood, A. E., Instrumentman, Battle Creek, Mich.  
 Kallosce, William, Gen. Mgr., Leonard Construction Co., Chicago.  
 Kennedy, R. E., Pilot Engr., B. & O., Baltimore, Md.  
 King, Coleman, Supvr., L. I., Jamaica, N. Y.  
 Leavell, J. C., Architect, Chicago.  
 Lichty, C. A., Inspector, C. & N. W., Chicago.  
 Lichliter, S. T., Supervisor, B. & O., Harrisburg, Pa.  
 Moore, Milburn, Eastern Engr. Editor, Railway Age, New York City.  
 McGuigan, J. F., Roadmaster, St. Louis, Mo.  
 O'Keefe, T., Asst. Supv., B. & A., Springfield, Mass.  
 Oliphant, A. L., Roadmaster, A. T. & S. F., Chanute, Kan.  
 Pollak, F. A., Asst. Engr., St. L.-S. F., St. Louis, Mo.  
 Purdy, J. W., Asst. Div. Engr., Banesville.  
 Potter, A. A., Dean of Engr., Purdue Univ., Lafayette, Ind.  
 Routerberg, H. M., Asst. Div. Engr., B. & O., Baltimore, Md.  
 Smart, G. G., Gen. Roadmaster, G. N., St. Paul, Minn.  
 Smith, G. S., Asst. Engr., M. P., St. Louis, Mo.  
 Smith, R. H., Railway Age, Cincinnati, Ohio.  
 Vandenburgh, E. C., Asst. Gen. Br. Insp., C. & N. W., Chicago.  
 Weeks, J. E., Instrumentman, G. T., Battle Creek, Mich.  
 Walcott, Ray, Draftsman, G. T., Detroit, Mich.  
 Willson, O. G., Bldg. Pilot Engr., B. & O., Baltimore, Md.

#### Purdue Alumni Luncheon

THE CHICAGO ALUMNI ASSOCIATION of Purdue University held its second annual luncheon at the University Club yesterday noon for alumni attending the annual convention of the American Railway Engineering Association. It was voted at the luncheon held in 1920 to make this an annual affair, the dinner to be on Wednesday of the week of the annual meeting. The object of the dinner is to get the Purdue men engaged in the railway field better acquainted with each other

<p>Chicago, Illinois.          March 16th, 1921.</p> <p>To our retiring President and fellow Alumnus in appreciation of his able direction of this Association during the past year.</p> <p>FURDUE MEMBERS          AMERICAN RAILWAY ENGINEERING ASSN.</p> <p><i>New Brown - 01</i>  <i>H. C. Lund '03</i>  <i>W. D. Pence (99-'06)</i>  <i>John M. ... '05</i></p>	<p><i>W. M. Neptune '06</i>  <i>F. C. ... '04</i>  <i>W. R. Roof '01</i>  <i>E. ... '05</i>  <i>A. W. Traugott '04</i>  <i>Walter ... '02</i>  <i>... '01</i>  <i>W. M. ... '09</i>  <i>T. H. David '01</i>  <i>W. C. Albright '03</i>  <i>J. E. ... '09</i>  <i>L. D. ... '14</i>  <i>J. W. ... '93</i></p>	<p><i>W. M. ... CE-'13</i>  <i>J. M. ... CE-'14</i>  <i>J. P. ... CE-'05</i>  <i>J. O. ... CE-'16</i>  <i>W. W. ... CE-'05</i>  <i>W. R. ... CE-'11</i>  <i>A. C. ... CE-'15</i>  <i>J. B. ... CE-'04</i>  <i>H. E. ... EE-'07</i>  <i>H. C. ... CE-'10</i>  <i>M. B. Davis CE-'12</i>  <i>W. H. ... CE-'99</i></p>
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The Cards of Presentation to Mr. Safford

and with the work being accomplished by the alumni in other fields of industry. Thirty-five men were in attendance yesterday as compared to 59 a year ago. The fact that fewer men were in attendance this year was due, to a certain extent, to the March stated meeting of the Signal Section of the American Railway Association being called off this year. Among those present at the luncheon yesterday were: H. R. Safford, retiring president of the A. R. E. A., and L. Downs, the president-elect, who are of the classes of '95 and '94. Others present included: G. W. Hand, assistant to the president, Chicago & North Western; W. K. Hatt, head of the School of Civil Engineering, Purdue University; C. C. Albright of Purdue University; and A. A. Potter, dean of engineering, Purdue University.

Short addresses were made by Messrs. Safford, Downs, Hatt, Potter and Albright. Mr. Safford emphasized the benefits which the young college graduate entering railroad service can derive from becoming a member of the A. R. E. A. By becoming a member, the younger man is in reality continuing his schooling in the practical lines of work he has adopted for his life work. Endless opportunities for co-operative relationship exist between the A. R. E. A. and the various technical universities and Mr. Safford emphasized the necessity of cultivating these opportunities.

Mr. Downs emphasized the fact that the older men can help the younger men by looking them up and getting acquainted with them and their problems. He stated that the younger men are not making themselves known to the older men who are alumni of their universities and who are engaged in the same line of work. Mr. Albright stated that the university is compiling a list of Purdue men who are engaged in various branches of railroad service.

A feature of the dinner last evening was the presentation to Mr. Safford of a badge by his fellow alumni who are also members of the A. R. E. A. In making the presentation Dean Potter spoke in part as follows:

"President Safford, the Purdue members of the A. R. E. A. have asked me to present to you in their name this badge as a mark of their esteem and as a recognition of your lively interest in the welfare of the younger men who are in the rank and file of the technical organization of our railroads. These alumni of Purdue University desire also to express their appreciation of your continued interest in your Alma Mater and your vision of the mutually serviceable relations that should prevail between the colleges and the railroads. The visiting committees which you appointed to advise with the faculties of Illinois and Purdue will prove most helpful to us and we hope will result in interesting an increasing number of our best students in the profession for which the A. R. E. A. stands. Your energies have found outlet not only in the technical and professional phases, but also in the improvement of human relation."

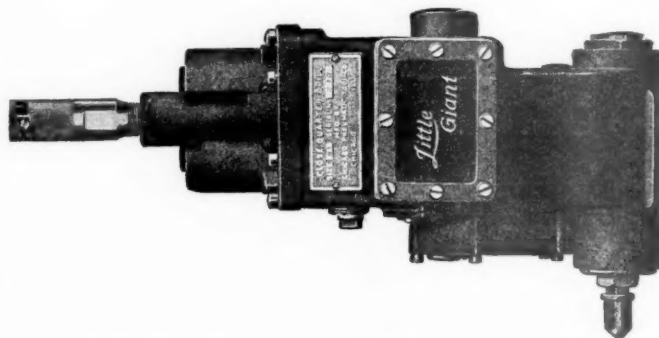
### A Throttle-Reversing Close Quarter Air Drill

IT IS INTERESTING TO NOTE that the Chicago Pneumatic Tool Company, New York, has recently remodeled its Little Giant Close Quarter Air Drill so that it is now available in reversing types and that the reversing is accomplished at the throttle. By reason of these features the machine is said to be greatly improved for tapping in close quarters operations and is proving highly useful both for drilling and reaming holes at rail joints, and as a wrench in connection with track repair and construction work. Below are given various figures relating to the

size and performance of the two models of the new machine.

Description	Capacity		Speed Light	Air Consumption Cubic Feet per Minute	Total Length Including Throttle	Length from End of Spindle to End of Feed Screw When Run In	Length of Feed	Distance Side to Center of Spindle	Net Weight, Lbs.
	Drilling	Reaming							
No. 81-R.....	1 1/4"	1 1/2"	240	25	24 1/2"	8 1/2"	2 1/4"	1 1/2"	36
No. 91-R.....	2"	1 3/4"	120	35	24 1/2"	9 1/4"	2 1/4"	1 1/2"	40

Similar to the non-reversible drills of this type, drilling can be performed within 1 7/16 in. of an end wall or corner. In them the power is transmitted to the drilling spindle by means of a compact train of gears which are



Little Giant Reversible Close Quarters Air Drill

said to insure smooth uninterrupted rotation, and give an increased drilling speed over the earlier ratchet types. The gears themselves are of the stub-tooth design, it being held that in this design the roots of the teeth are relatively much stronger than in gears of the involute type.

### A Rail Failure Chart

HOW TO DETECT a defective rail before it breaks is one of the most difficult problems imposed on the section foreman. This becomes well-nigh impossible in many cases of transverse fissures, but owing to the serious consequences which follow the ultimate failure of rail containing a fissure, it is extremely important that these fissures be detected whenever any external evidence is shown. Information as to the nature of these troublesome flaws in rail steel is also of considerable importance to the foreman in order that he may report the rail failures accurately.

As a means for clearing up some of the misunderstandings concerning the transverse fissure and to assist in their detection, Robert W. Hunt & Co., Chicago, has issued a chart or card of instructions to section foremen illustrating three types of transverse fissures by a group of eight photographs. The card also contains an explanation of the nature of these fissures and details the various external manifestations by means of which some of them may be detected.

### Roadmasters' Dinner

Over 50 members of the Roadmasters & Maintenance of Way Association met at dinner at the Auditorium hotel last evening to discuss the work of the Association and means of promoting a successful convention, scheduled to be held at the Auditorium hotel in Chicago next September.